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AUGUST 2001

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AUGUST 2001  
Volume 19, Issue 8

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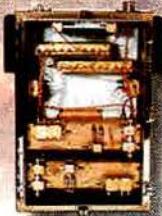
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Never ignore the human factor



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## "Let's improve ... " letter offends dealer

Hudson Denney's letter in the May 2001 issue of *MRT* "Let's Improve our Position in the Marketplace" offends me when it describes most dealers as being a part of a "low-brow, low-tech industry made

up of has-beens and wash-ups."

Could Mr. Denney have been moved to say such a thing because he is tired of having dealers tell him that they don't need his radios because their customers already

bought service from Nextel? Thousands of hard-working, professional individuals have fought—and continue to fight—a war against bottomless-pocketed mega-corporations that U.S. government legislation has enabled and has allowed to monopolize and decimate a thriving, competitive radio communications industry.

Many of us, sometimes without much manufacturer support, use as much creativity as possible to package sales and service, and we sustain the educational expense to keep our employees up to date about new technologies. From his letter, I gather that Mr. Denney might be frustrated because relatively few major manufacturers produce products tailored to use newer technologies on radio communications frequencies, as opposed to wireless telephone frequencies.

It will take more than one development to renew the radio communications industry. I wonder whether that's because asking manufacturers why this or that new technology is not yet developed would reveal their belief that the radio communications marketplace has too little potential to justify the expense of new product development. Mr. Denney's letter seems to say that he also believes that manufacturers ignore dealers' product needs in hopes that dealers will disappear.

I would rather not be numbered among those included in his letter's description of how he sees most dealers. I am proud to still be a dealer. Mr. Denney's letter does not reveal a similar pride.

—Floyd H. Miltz  
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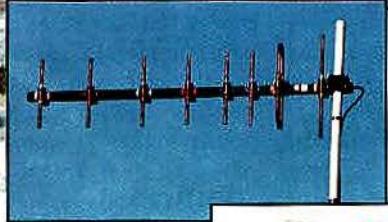
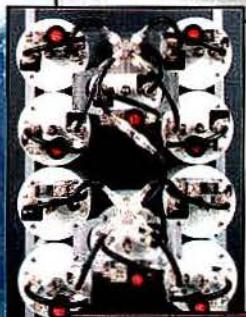
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# The times of lower frequencies and glowing tubes

Did you ever hear those discussions of how U.S. Air Force radios are so much more sophisticated compared to those on Russian



military aircraft? How the poor Russians—*imagine*—still use *tube-type* equipment?

Then someone pointed out that tube-type equipment resists damage from electromagnetic pulses caused by nuclear explosions. Transistor equipment might be vulnerable. Um, maybe there's something to those vacuum tubes. Maybe we ought to go back to vacuum tubes.

Which brings us to VHF land mobile radio and 800MHz interference. Hang on; I know it's a sharp turn.

For years, public safety agencies have migrated to ever-higher frequencies in pursuit of additional communications capacity and more features. Nowhere is this more evident than in large cities and heavily populated states. Even so, the majority of the nation's 17,000 state and local law enforcement agencies still use VHF.

Public safety agencies took advantage of the opportunities to use 800MHz frequencies not reserved for their use, but were nevertheless available to them if otherwise unoccupied. This placed their channels adjacent to commercial users. That was not a problem while commercial operators and public safety systems used compatible technology: relatively few high-elevation sites,

high power and analog modulation.

When commercial channels converted to low-elevation, low-power, digital modulation system architecture that emulated cellular telephone systems, then it became a problem. As commercial digital system base stations speckle the public safety system coverage area, they blank out public safety radio reception within various distances from the commercial towers.

Nextel towers seem to cause the most problems because that company's frequencies are more often closer to channels used for public safety radio. Also, its digital modulation fills to the edge (and some say spills over) its channel bandwidth in a way analog modulation does not. But interference can also come from cellular carriers on nearby frequency bands, farther away than adjacent channels.

Now let's say it as it is: The commercial carriers would just as soon the public safety users put in more antenna sites to increase signal strength and overcome the interference. They would just as soon public safety users buy more expensive portables—the most expensive, actually—that offer incrementally better interference rejection. They would just as soon public safety users sign up to use the commercial networks and forget about having their own.

On the whole, they would prefer that public safety radio users obtain and spend taxpayer money to take those steps so commercial carriers don't have to reduce power, abandon various frequencies, avoid certain tower locations or use transmitter filters.

Meanwhile, VHF starts looking good in comparison. It's so far removed from 800MHz that there's no interference from those digital systems. Too bad not enough VHF frequencies are available for new urban systems.

Some have tried.

An innovative scheme for a statewide public safety system in

Wisconsin proposed the use of VHF frequencies. The U.S. Army released an initial 20 VHF channels to the state. The state built a pilot system with four sites for digital trunked radio communications. It covers the I-90 and I-94 interstate corridors from Beloit to Eau Claire.

Too bad the remaining channels needed for statewide coverage won't be forthcoming. It would require the army to release frequencies in other parts of the state and for county sheriffs to kick in some of their VHF channels, and they're too reluctant. Wouldn't Wisconsin have a beauty, though? A digital trunked system so far from 800MHz that Wisconsin could scoff at interference from cellular-type systems.

No one in the federal government is *noticeably* stepping up to pressure commercial carriers on the digital interference problem. Following music played by Congress, the FCC dances toward the Sept. 12 auction for 700MHz spectrum. The FCC is seemingly unconcerned that the rules it modified to help commercial carriers avoid TV interference will, unless reversed, set the stage for interference to public safety systems similar to what they now receive in the 800MHz band.

Where's a congressman, a senator, a commissioner or even a bureau chief who will speak out?

We *like* what VHF has to offer. There just isn't enough of it for the largest cities. The FCC must fix the rules for the 700MHz band before the auction, and it should hold commercial carriers responsible when they cause 800MHz interference.

Put that in your vacuum tube. It'll smoke itself.

*Don Bishop*

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CIRCLE (8) ON FAST FACT CARD

## Save the heroes

The term "public safety" does not do justice to the dedication, hard work and heroism of firefighters, police and EMS.

Firefighters constantly face potentially fatal situations. Yes, it is their job, but we should be looking

at every possible solution to improve the safety of that job, to save their lives when they are saving others.

A small business in Huntsville, AL, has done just that. Time Domain Corp., under Phase 1 of the Small Business Innovation Research program from the Department of

Commerce, has demonstrated a wireless technology that could track firefighters through heavy smoke, fire or dense steam. Time Domain and application developer Intelligent Automation of Rockville, MD, have submitted a Phase 2 SBIR proposal to build a fully functional prototype system that could help save firefighters' lives by providing precision tracking and communications inside burning buildings.

If the Phase 2 proposal is approved, (which means that the companies win a contract for as much as \$300,000 to continue the research), the companies will jointly develop a radio named "Ultra" (ultra-wideband location-tracking radio).

The Ultra radio would be a small, light, battery-operated device that would be integrated into the firefighter's uniform. Its projected range is 100m-200m in hazardous environments.

According to Intelligent Automation, this radio does not transmit continuous radio waves like conventional radio. Only pulses are transmitted, and power is used only during the short duration of those pulses. A typical duty cycle is 0.5% with pulse widths of 0.5ns. The low-frequency component of this radio's signal allows the radar

to see through foliage and walls, while the high-frequency component provides high resolution. (Supposedly, this radio generates no interference, operating below FCC Part 15 device levels.) Two radios would recognize each other's proximity to within about 1".

Another lifesaving device that already exists is the thermal-imaging camera. However, these cameras are expensive, and all taxpayers aren't willing to pay a little more to increase safety for everyday heroes.

Either one of these technologies could have saved the life of a Phoenix firefighter who died in a burning supermarket in March. Bret Tarver ran out of air and became lost, incoherent and disoriented. As reported on Firehouse.com by Heather Casey, some kind of collision knocked Tarver and his partner off the hose line. The two became separated. The partner was rescued, but Tarver was a "big guy and too disoriented to cooperate," one of the investigators said. His body was found under a table used to prepare meat.

Whether it's a tracking system, a thermal-imaging camera or a simple portable radio, the public safety community should always consider acquiring any device that will possibly save the life of a hero. Taxpayer education about these technologies can only help this cause.

One posting to Firehouse.com's Web site said the toughest thing about being a firefighter is "attending wakes and funeral services, and then going out on the next alarm without our buddy at our side."



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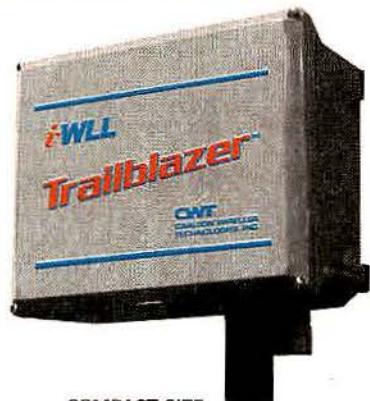
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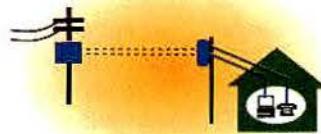


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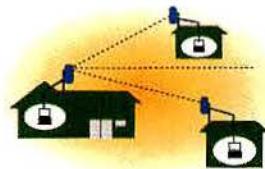
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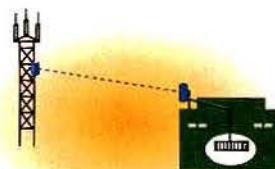
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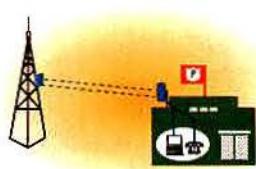
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# Delegation and education on 'auctionization'

By Robert H. Schwaninger Jr.

There is a flurry of unrequited interest in the upcoming (now postponed) auctions of VHF and UHF common-carrier channels. The FCC is also tossing in some 900MHz channels that nobody picked up in that earlier auction. In all, more than 10,000 discreet channels are on the block, and a lot of local operators are itching to get at them.

The primary prizes are the traditional RCC channels first used for Improved Mobile Telephone Service 30 years ago. Many of those channels were later converted to provide paging service when cellular tore up

Some of the UHF pairs were never used much. They were licensed to RBOCs that used them about once per presidential administration, mainly to tell a maintenance crew to go knock out your phone service until you paid the bill. Vinny and the other guys in the crew were later outfitted with cellphones, so the remaining stations were often of the single-stick variety, with a license held by a large LEC. Unfortunately, these place-keepers on the regulatory landscape were usually only burping out a station ID—from the center of the best urban markets.

To divest themselves of unwanted, unused (and sometimes unconstructed) assets, the RBOCs sometimes sold off some of these licenses for single-site facilities. Sometimes the price was reasonable, and sometimes it was just plain cheap. One such garage sale included 10 channels at 10 sites, with the equipment tossed in for \$50,000. The LEC's idea was that the future was broadband, and you just couldn't offer that on old RCC channels.

The FCC's database reveals a hodgepodge of licensing on VHF and UHF channels, with many unused or underused frequencies throughout market areas. Don't assume that the rural areas are unlicensed. These channels were also popular for that dinosaur, Rural Radio Service, and some of those systems are still cooking.

Now, there is converging interest in collecting a few blocks of these babies. Entrepreneurs see a chance either to fulfill pent-up demand for paging system build-outs or to stack blocks neatly and provide UHF or VHF trunked service to an underserved business and industrial market. Truth is, these channels work well—particularly for local operators seeking a big bang in rural

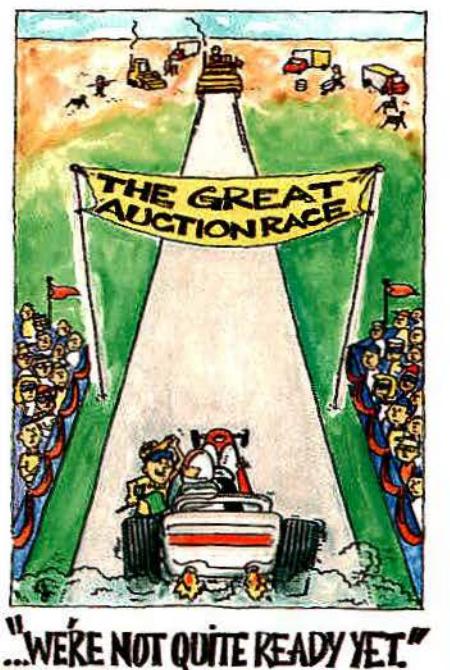


Illustration by John Hayes

the IMTS market. Then paging migrated to the 900MHz band, and, once again, those channels became less-used spectrum.

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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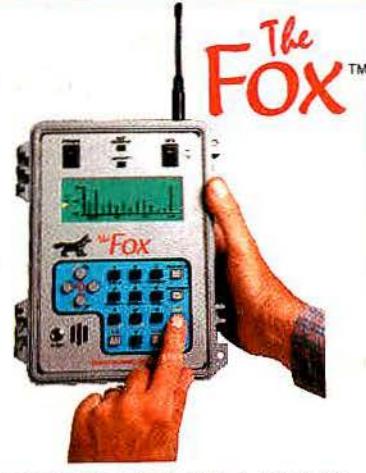
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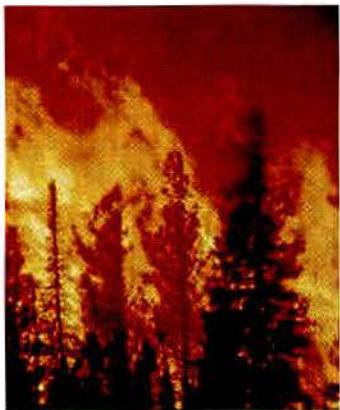
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markets where a cellular signal bumps over the terrain, afraid of its own shadow.

**Duh-legation**

When the FCC announced readiness to auction this spectrum, we alerted our clients. Many called back to find out the ins and outs of the auction process, including which rules to follow to obtain bidding credits, to demonstrate eligibility in the application preparation, and to determine if they would have to report their inheritance from Aunt Minnie in the financial data.

I was ready. I had delegated. Enter the cavalry in the form of Delaney DiStefano, a.k.a. my auction guru. You see, I had tried to read the rules, booklets, forms and charts and to learn about the concept of exponential smoothing. (Really—the FCC cares about well-smoothed exponents.) But, at some point, my eyes got bleary, my brain checked into a clinic for the chronically bored and my chin bounced off the desk blotter. Time to delegate.

Many auctions ago, I designated a member of my staff—Delaney—to become the world's leading expert on FCC auctions. Although this title is unlikely to get her on the cover of *Time*, it is essential to making sure the clients (and I) have our "go-to" person for auction stuff. Delaney has become a combination grizzled veteran, encyclopedia, soothsayer and all-around legal eagle, making sure that every *t* and *i* are in place to ensure our clients' best chances to be successful bidders.

Unbeknownst to all (well, now I've shot my mouth off), Delaney enters my office before each auction and provides me with a rundown of all of the auction rules, nuances, changes and software wonders that are included in each upcoming sale. I sit there and lap it up in big gulps, asking such probing questions as, "Has the FCC ever considered a double-coupon day?"

My lessons have taught me that every auction participant should

have someone who truly knows their way around the process. It's one thing to read the rules and reports. It's quite another to devote weeks of time to ensuring that the application and the bidding process go off without a hitch.

**Brain delay**

So, with Delaney's help in steering the course, my office completed a number of applications for clients seeking to enter the paging auction. Each application was completed with care, including the proper collection of financial and ownership information. Delaney poured over the newest changes in the process and ensured that each question regarding each applicant was answered correctly. Although she did

not complete all applications, Delaney made sure that the rest of the staff didn't screw them up, while pro-

**"Has the FCC ever  
considered a double-  
coupon day?"**

viding insight into new wrinkles in the attribution rules. We, and our clients, were ready for the big game.

Then the %\$#! FCC postponed the auction! We were ready. Our clients were ready. The market was ready. Everything was a go. We even purchased new computer equipment to make sure that there would be no hardware problems that couldn't be immediately overcome.

But the FCC wasn't ready. It seems that when the FCC beta-tested their newest bidding software, it didn't perform up to expectations, or so they said. They postponed the auction for four months and sent the software back to the code crunchers and cyber-geeks that make all of those virtual checkboxes. (With all of the dot-com layoffs, you'd think the FCC would be well supplied with quality geeks.)

So, here we sit with our motors running. Our clients are ready for the big game, with financing and business planning in place. My staff is on "yellow alert" for any new developments. We're all ready to play, FCC. Could you take part of that auction money and buy a starter's pistol? ■

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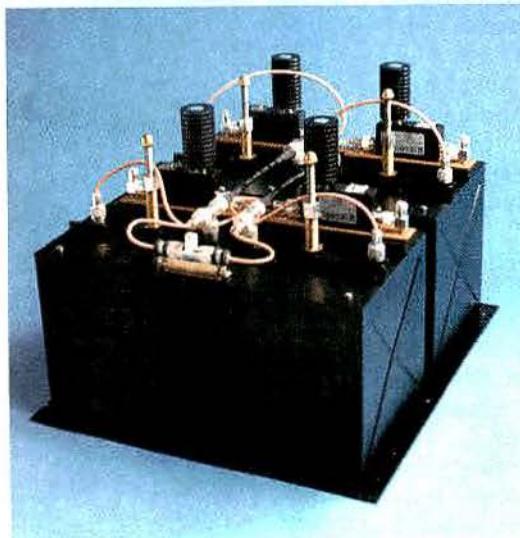
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# Interoperability simplified

Turn on the scanner'

By David O. Dunford

At the APCO national conference in Little Rock, AR, back in 1989, Dave Wooldridge, then a senior VP for Motorola, led a high-powered presentation fo-



Interoperability can be achieved with simple 'listening' among jurisdictions. An officer caught a suspect just by hearing a call on his scanner.

cused on that firm's trunking radio products. The component of the presentation that I recall most vividly, however, dealt with the flexibility of the then-new Centracom II console system in meeting the

Dunford, MRT's public safety consultant, is technical services consultant for the Lenexa, KS, Police Department. He is a member of the Association of Public-Safety Communications Officials—International. You can email Dunford at [mrt@intertec.com](mailto:mrt@intertec.com).

needs of agency "interoperability."

That was my first exposure to the use of "that word," as applied to public safety communications systems and operations. Ah, we long for the simpler times.

As with other topics presented in this column, I have opinions about "interoperability"—about the word itself and about the oft-tangled web woven for the benefit of proprietary-protocol radio peddlers and the erstwhile rescuers of our communications systems' failings.

As for the word itself, when uttered slowly and with a slightly furrowed brow, it appears to bestow an aura of sincere concern upon the speaker. (After all, we must know what we're doing—we're "for" interoperability.) As for the marketers offering products to provide us with the benefits of "interoperability," I'm far less certain—or trusting—of alleged improvements or advantages.

It's not that I'm opposed to technological progress. I am a smidge suspicious, however, about any profit-driven firm offering a high-priced proprietary solution to which we must marry successive years' allegiance and budgets. So, what's Radioman to do?

Plenty, it turns out, and at minimal cost, too.

Recently there was a daylight, Saturday bank robbery at a local savings and loan in our city. The victim gave a great description of the suspect and his vehicle, and the information was quickly relayed to the communications centers in the area. An alert corporal with the nearby Leawood, KS, Police Department heard the information, spotted the vehicle, gave chase and apprehended the (alleged) crook (who doesn't even get to keep the money).

This was a textbook case for interoperability: Didn't we do a

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good job? Aren't we smart? Well, the answers are "yes" to the former question and "not exactly" to the latter because the plot thickens. It turns out that the motivated Leawood copper didn't hear the pickup information on his dispatch radio. He heard our city put the call out directly on his scanner. Yes, the lowly scanner, the bane of Radioman's repair existence and the scourge of communications technology, came to the rescue of mighty interoperability.

Understand that the scanner didn't actually catch the crook during the foot chase after he wrecked the stolen car. It didn't tackle and arrest him after he slowed down in the summer heat, either.

However, consider the pedigree of Mr. Scanner: all-bands, all-protocols and all for less than \$240. No, it doesn't transmit, but what a blessing that it receives and that someone was listening.

With this sort of reliable, cheap and simple tool available, public safety can take a big step toward "improving interagency operations" (which is really just cooperation and the sharing of information that permits us to help each other out). By the way, can everyone else hear what your officers are saying? ■

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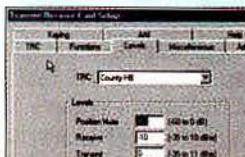
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# Voice-over-~~Intranet~~ protocol for critical communications

Public safety can actually best leverage the power of IP-based networks with an intranet system.

By Jay Herther and Bill Haymond

Internet protocol-based technologies and services have taken the telecommunications market by storm. Once just a data-only transfer mechanism, IP is quickly en-

Internet), some land mobile radio companies have either fielded products or announced future plans to provide critical-communications-grade IP networks and equipment.

Some misconceptions exist about the application of Voice-over Internet protocol to land mobile radio. Examining and dispelling some of the myths associated with VoIP for critical communications will make it apparent that VoIP technology provides significant customer benefits when properly applied.

The principal requirements of criti-

ceptions result from confusion about the application of Internet concepts to critical-communications requirements. As a digital, packet-switching network, the Internet is a powerful communications medium. But because it is a *public* entity, designed for *data* communications, it is not suitable for critical *voice* communications. It cannot support the fast access times, call priorities and security required by public safety. Furthermore, the common VoIP vocoders that are used to insert digitized voice into the packet-switched data stream are not sufficiently robust for the public safety communications environment.

## Advantages of an intranet

A well-designed and managed private *intranet* can leverage the power of an IP-based network while compensating for the deficiencies of VoIP over the *Internet*. The intranet can be designed to provide the fast response times, excess network capacity, high-quality voice and security that are needed for critical communications.



Software-based, digital VoIP radios put versatile, secure communications into the hands of users in the field.

croaching on the voice-communications market. The public safety marketplace, in particular, is an area with keen interest in this technology. While most of the industry focuses on voice-over-IP services related to low-cost telephony (such as long-distance calls over the

cal communications networks—reliability, fast access, multiple users and agency broadcasts, and transmission of high-quality voice and data—all can be met with a VoIP *private* intranet tailored for public safety.

Many VoIP myths and miscon-

Herther is director of product integration and Haymond is director of systems technology for M/A-COM Wireless Systems, Lowell, MA. Herther's email address is [herther@tycoelectronics.com](mailto:herther@tycoelectronics.com). Haymond's email address is [haymondw@tycoelectronics.com](mailto:haymondw@tycoelectronics.com). AMBE is a registered trademark of Digital Voice Systems Inc. (DVS). For more information: [www.opensky.com](http://www.opensky.com).



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All of these characteristics cannot be guaranteed over the Internet.

Table 1 summarizes the fundamental differences between voice over

the Internet and voice over a private intranet.

Table 1. A comparison of characteristics of Internet and private IP intranet networks.

Characteristics	Internet network	IP intranet network
Voice quality	Inconsistent and ranges from fair to poor	Consistent and high quality
Latency	Dependent on network traffic; unpredictable during peak hours	Engineered to provide acceptable latency during peak hours
Guaranteed class of service	No established priorities and no guarantee of emergency call delivery	Different priority levels available, including emergency call delivery
Dispatch functions	Advanced patch and simulselect functions not available	Advanced dispatch and computer-telephony functions available, including summation, console preemption, radio and telephone patching, and paging
Security	Susceptible to hackers	Secured with encryption

### Packet-switched vs. circuit-switched networks

The key to understanding IP-based technology is the concept of *packet switching*. Traditional voice communications networks (telephony or land mobile radio) are *circuit switched*. In circuit switching, users have exclusive use of the connection (a circuit or radio channel) until the conversation has concluded and the connection is released. In packet switching, the messages are divided into packets, and multiple users share access to a circuit or channel by taking turns placing their packets onto the channel. Packet switching became the basis of Internet communications and was extended to telephony

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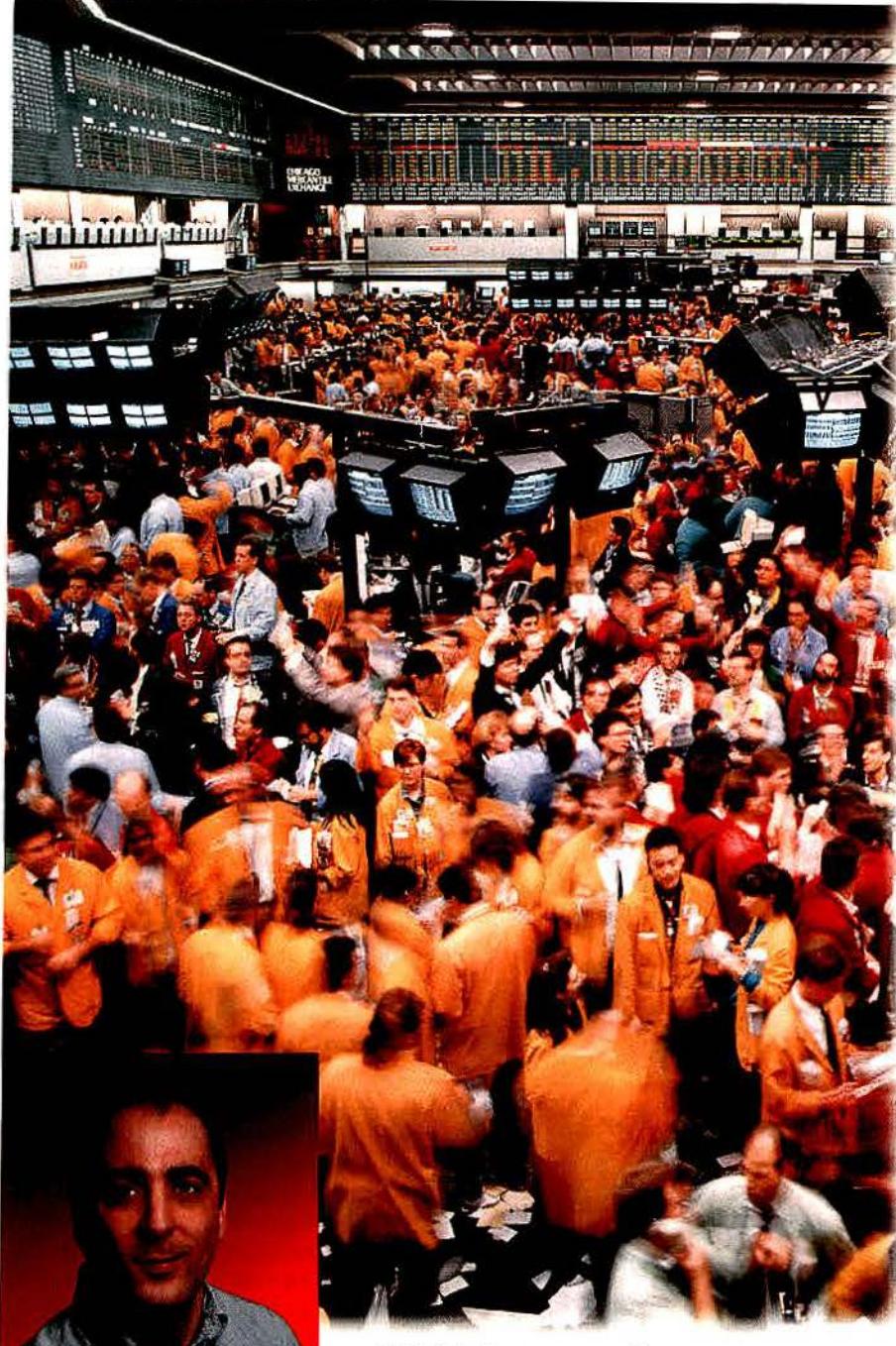
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I recommend this product. If it can take on the bears and bulls in my field, I'm sure it can handle anything in yours." -Brad Brieman

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with the advent of *asynchronous transfer mode* switches, which are high-bandwidth devices used to switch conventional telephone voice calls.

The main advantage of packet switching is *capacity*. Many users can share a telephone line or radio channel. A secondary advan-

tage is the *redundancy* associated with a packet-switched network. After a message or voice call is divided into packets, the individual packets can take different paths through the network to the final destination, where they are reassembled into the message. This permits a high degree of re-

dundancy and reliability in the network architecture.

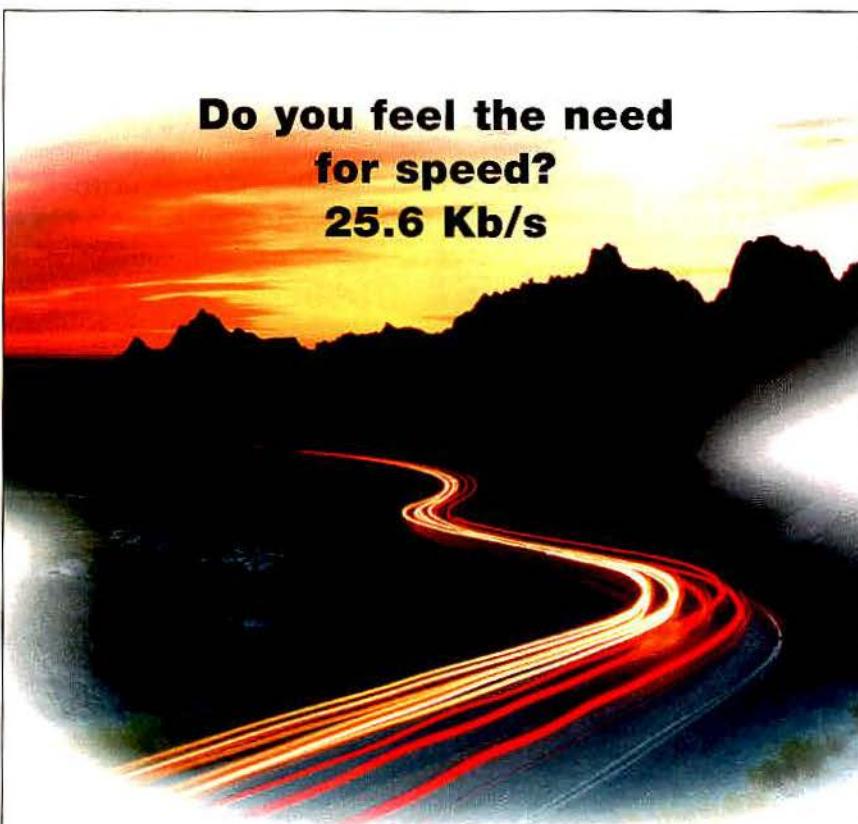
Each radio, personal computer or subscriber device in an IP network has a unique IP address. Messages include a header that contains source and destination IP addresses. Each router functions as a small packet switch that, on receiving a message, looks into the header and routes the message based on the destination IP address. Because there are usually many routers in a system, a *distributed switch architecture* results, which has an inherent ability to compensate for device failures or congestion points. This distributed IP architecture provides an enormous redundancy benefit, one of the key requirements for most public safety communications systems.

Circuit switching, on the other hand, is essentially a *centralized switch architecture* with natural bottlenecks at the switches or individual circuits.

### Maintaining high-quality voice

Typical VoIP applications use the H.323 telecommunications standard, which includes the G.723.1 low-bit-rate vocoder. H.323 is not suitable for critical communications because it does not offer group, priority, preemption or emergency calling—all required for public safety applications. Also, the H.323 suite of vocoders was designed for point-to-point telephony voice applications. It is inappropriate for use in moving vehicles with traffic noise in the background or for communications over a low-bandwidth radio channel that is subject to multipath fading. This is why we designed an intranet system using DVS's AMBE vocoder, which has been optimized for superior performance in the high bit-error rate environments typical of public safety mobile communications.

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listen to conversations. By providing end-to-end encryption and operating over a private intranet system, security is maintained throughout the network. The backbone of M/A-COM's intranet system, called "OpenSky," carries

voice messages in compressed and encrypted formats. Compression significantly increases the voice traffic capacity of a typical network. End-to-end encryption means that voice communications are encrypted over the air and over

the packet-switched network backbone, thereby eliminating all possible hacker entry points.

### Cost benefits

The key to savings for a voice-over-intranet system is the use of commercially available off-the-shelf switching equipment and reliance on standard software, as opposed to purpose-built, proprietary, switching hardware and software. This enables competitive procurement of standard IP routers from multiple suppliers, as well as network management systems that operate on Unix workstations. These products provide customers with "economies of scale" cost savings and transparent upgrades. The IP architecture is highly scalable; adding capability is as easy as expanding a LAN.

The key advantage is that the distributed IP network can be upgraded and expanded incrementally and economically, unlike a fixed system that requires a complete "forklift" upgrade once it has reached maximum capacity.

In addition, the IP-based architecture uses established, ubiquitous IP standards that will withstand the test of time and are a much safer long-term investment. In an IP-based architecture, data applications are "plug and play," and hence, integration costs are drastically reduced. For example, a data application can be integrated on a wired LAN and then easily ported to a wireless application without the need for any middleware.

Voice over IP allows the true integration of voice and data. By using Time Division Multiple Access technology, it is possible to have voice and data capability in "one radio, one infrastructure and one channel," providing users a two-to-one cost savings over separate voice and data systems.

### Creating a network

Table 2 summarizes the comparison between a traditional LMR network and an IP-based voice and data network. M/A-COM's IP-based

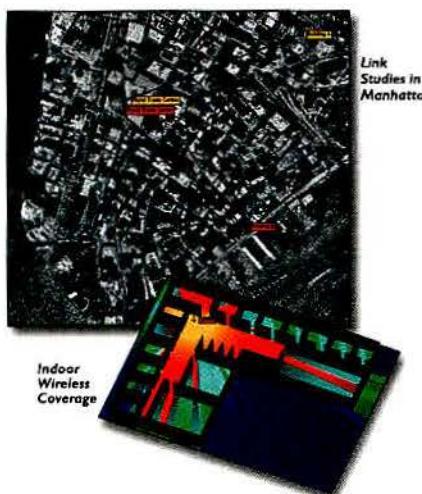
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SS-12	10	12	1 1/2 x 6 x 9	3.4
SS-18	15	18	1 1/2 x 6 x 9	3.6
SS-25	20	25	2 1/2 x 7 x 9 1/2	4.2
SS-30	25	30	3 1/4 x 7 x 9 1/2	5.0

## DESKTOP SWITCHING POWER SUPPLIES WITH VOLT AND AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2 1/2 x 7 x 9 1/2	4.2
SS-30M*	25	30	3 1/4 x 7 x 9 1/2	5.0

## RACKMOUNT SWITCHING POWER SUPPLIES

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-10	7	10	3 1/2 x 19 x 9 1/2	4.3
SRM-12	10	12	3 1/2 x 19 x 9 1/2	4.7
SRM-18	15	18	3 1/2 x 19 x 9 1/2	5.0
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

## WITH SEPARATE VOLT &amp; AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30M	25	30	3 1/2 x 19 x 9 1/2	7.0

## 2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30-2	25	30	3 1/2 x 19 x 9 1/2	11.0

## WITH SEPARATE VOLT &amp; AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
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ICOM IC-F11020 & IC-F2020  
KENWOOD TK760, 762, 840, 860, 940, 941  
KENWOOD TK760H, 762H  
MOTOROLA LOW POWER SM50, SM120, & GTX  
MOTOROLA HIGH POWER SM50, SM120, & GTX  
MOTOROLA RADIUS & GM 300  
MOTOROLA RADIUS & GM 300  
MOTOROLA RADIUS & GM 300  
UNIDEN SMH1525, SMU4525  
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CIRCLE (23) ON FAST FACT CARD

## NEW SWITCHING MODELS

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SS-18GX  
SS-12EFJ  
SS-18EFJ  
SS-10EFJ-98, SS-12-EFJ-98, SS-18-EFJ-98  
SS-12MC  
SS-10MG, SS-12MG  
SS-101F, SS-121F  
SS-10TK  
SS-12TK OR SS-18TK  
SS-10SM/GTX  
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX  
SS-10RA  
SS-12RA  
SS-18RA  
SS-10SMU, SS-12SMU, SS-18SMU  
SS-10V, SS-12V, SS-18V

Table 2. A comparison of parameters of traditional LMR and IP intranet networks.

Parameter	Traditional LMR network	IP network
Network scalability	Not easily scalable	Easy to add users and to expand the network
Hardware components	Proprietary and unique	Off-the-shelf, cost-effective routers and workstations
Data applications	Unique, difficult to integrate	Based on TCP/IP and CDPD standard; data applications are "plug and play"; "middleware" is not required
Switching	Circuit switched	Packet switched
Network access	Dial-up modem style	"Always-on"; connectionless
Network administration	Unique	Uses standard IP tools such as IP addressing and diagnostics
Features	Full feature set per APCO 16	Full feature set per APCO 16

network configuration (Figure 1) uses a wide-area intranet backbone to handle multiple switching centers by connecting the Ethernet LANs in each regional operations center. A primary design objective was to use industry-standard and field-proven hardware and software components wherever possible. The Internet protocols, including TCP/IP and UDP/IP, and the CDPD (IS-732 standard) architecture were selected because they have become *de facto* industry standards. The resulting network enables each radio to handle integrated voice and data on the same RF channel simultaneously, using TDMA to provide two to four simultaneous voice calls for each 25kHz channel. With an "always-on," end-to-end, IP connection, and with each radio having its own unique IP address, true

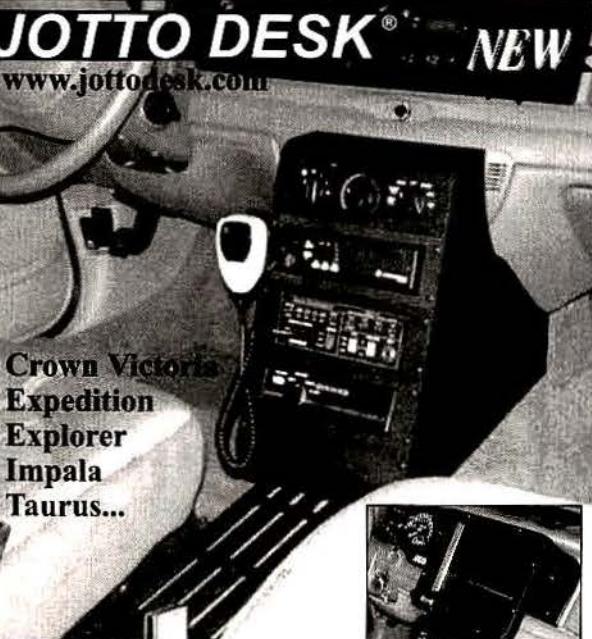
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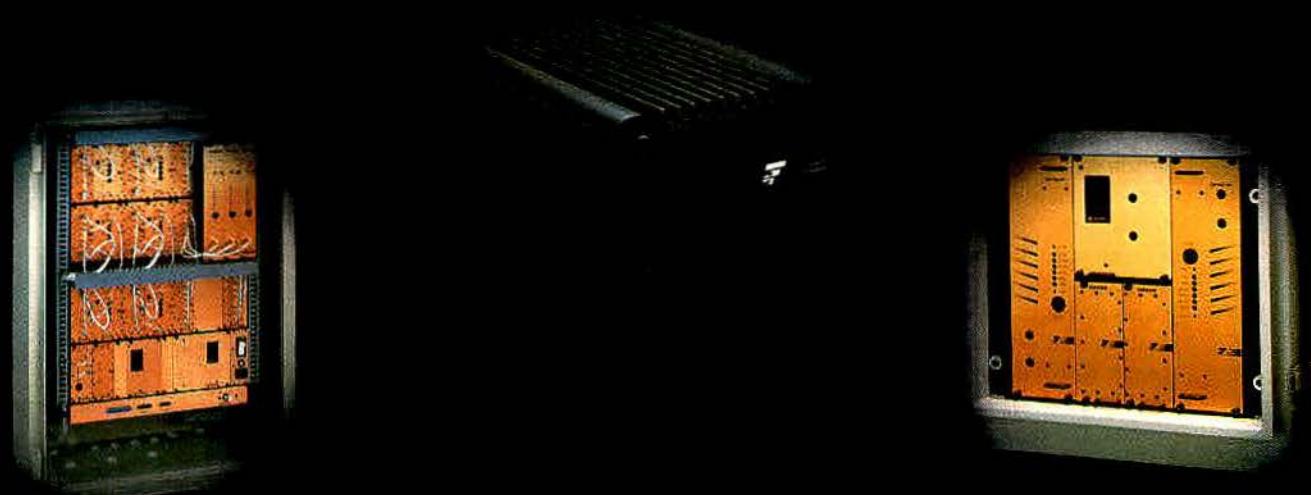
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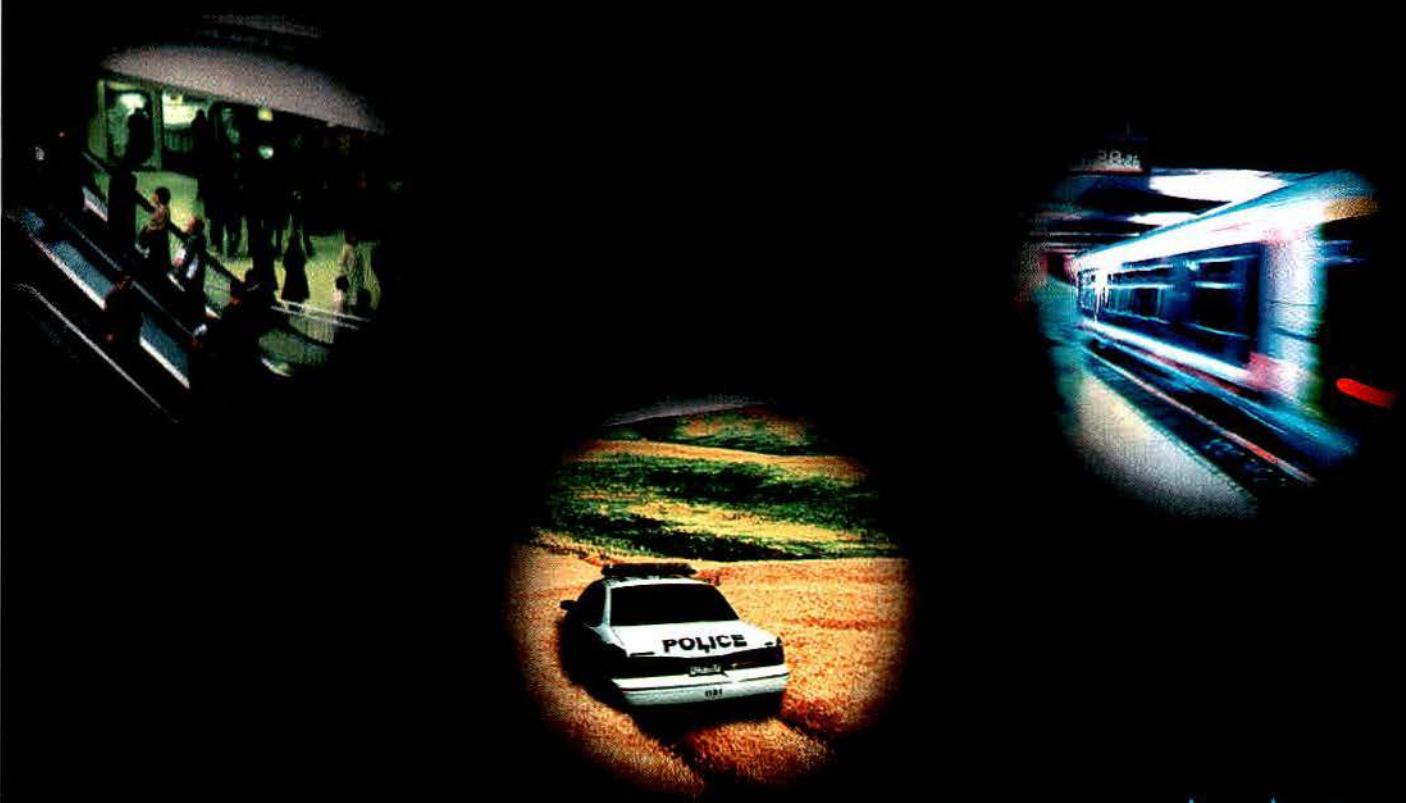
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end-to-end IP connectivity is maintained throughout the network. Over-the-air software provisioning provides automatic downloads for software updates to radios in the field. The air-interface protocol employs advanced channel arbitration and error correction to achieve stable performance. Security is maintained throughout with encryption of the IP backbone and the air interface.

#### Implementation need not wait

Many manufacturers are endorsing IP and claiming a VoIP system in their "future vision" for public safety communications. However, "voice over the intranet" is available now. An end-to-end IP network can provide all of these benefits. Three simple questions should be asked when determining whether a system is truly IP-based:

1. Does the system deliver end-to-end IP services/applications?

2. Is the network packet switched?

3. Does every piece of radio, routing and switching equipment have its own IP address?

A truly IP-based wireless private network can be implemented now for private land mobile radio applications. A private intranet radio network, rather than a public IP network, is a cost-effective way to provide the capacity required to ensure high-quality, maximum-clarity voice packets in all communications, especially during peak periods. This end-to-end design also enables the use of

data applications without middleware for wireless networks that employ IP as a transport mechanism. Unlike other forms of VoIP, notably those designed to operate over the Internet, a private network can compensate for time-delay latency to provide high-quality voice.

Wireless IP, such as the Open-Sky network, provides priority and preemption, mobility tracking and group calling services among a complete suite of services geared to the needs of the government and public safety users. ■

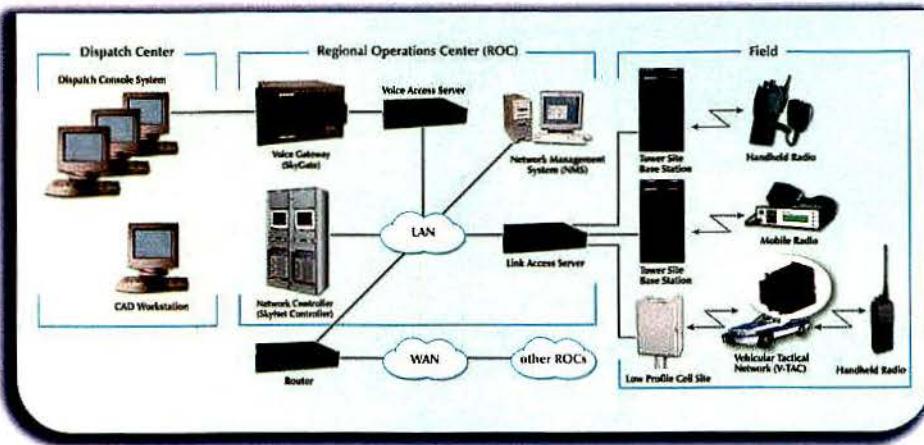


Figure 1. Creating a wireless private intranet network.

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CIRCLE (27) ON FAST FACT CARD

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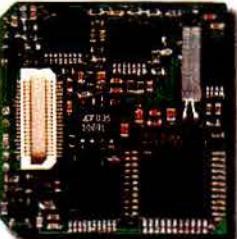
**MIDIAN ELECTRONICS INC. WINCAD 300TVS**

File Edit Functions Tools Windows Help

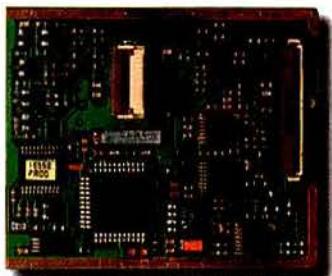
**Traffic**

ID	Name	Last	Status	Cross Street 1	Cross Street 2	Dispatch
1536	Chief P. Jackson	6/5/01 2:45:55 PM		Alvernon	22nd	
2213	Det. J. Perez	6/5/01 2:44:33 PM			Prins	
6216	Det. R. Keler	6/5/01 2:45:18 PM		Tucson	22nd	
0073	Insp. R. Ciron	6/5/01 2:44:09 PM		Windol	Prince	Called 0873
5324	Lt. P. Jones	6/5/01 2:45:10 PM		Alvernon	Grant	
2689	Sgt. D. Simmons	6/5/01 2:45:35 PM		Alvernon	Glen	
3247	Sgt. L. Gonzales	6/5/01 2:44:27 PM		Alvernon	Speedway	
4833	Sgt. Y. Lee	6/5/01 2:45:59 PM		Kob	Prins	

2:46:59 PM 6/5/01

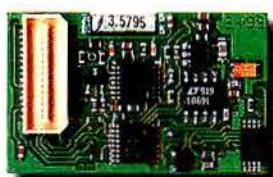


**TVS-2 VX:** For Vertex VX-210A/400/800/900 portables

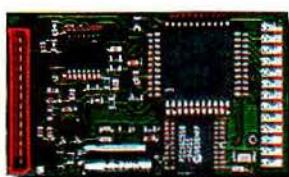


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# Many out of one: Multicoupler basics

By Harold Kinley

What do you do when your "boxes" outnumber your available "sticks"? In this business, it is often necessary to feed more than one receiver from a single antenna connection. This is generally referred to as *multicoupling*. Techniques to accomplish this vary widely, depending on the available signal level and other factors such as required isolation and good engineering practice. Methods of multicoupling range from the simple to the complex, so let's start with the simplest arrangement.

direct connection does not maintain the  $50\Omega$  system impedance and does not provide any isolation between the receiver ports (tee connector). This arrangement is only used when lack of isolation is not a problem and the signal level is fairly high (not near the receiver threshold sensitivity).

More than two receivers can be combined by using more tee connectors. For example, two tee connectors can be used to feed a single antenna to three receivers as shown in Figure 2 on page 32. The number

of ports. The loss will be greater for dividers with more output ports. The loss between the input and any output port can be calculated as

$$L = 20 \log \left[ \frac{1}{N} \right]$$

where

$L$  = loss in decibels

$N$  = number of output ports

The system impedance will be maintained, and some small amount of isolation will be between receivers. However, the resistive-divider network is inefficient and usually an undesirable way to provide multicoupling.

## Transmission-line transformer

To maintain a constant  $50\Omega$  system impedance, a quarterwavelength transmission line of the proper characteristic impedance can be used as an *impedance transformer*. For example, to feed the input of two receivers from a single antenna, using a simple tee connector as a splitter will reduce the impedance at the splitter input to about  $25\Omega$ . This is because the two  $50\Omega$  receiver inputs are connected in parallel and thus produce a  $25\Omega$  impedance.

If the  $50\Omega$  impedances of the receiver inputs were to be transformed to  $100\Omega$  and then combined at the tee connector, the resultant impedance would be  $50\Omega$ . This would maintain the integrity of the  $50\Omega$  system impedance. You can closely approximate this by using a quarterwavelength of  $75\Omega$  transmission line. To transform the  $50\Omega$  receiver-input impedance to  $100\Omega$  would require a quarterwavelength of transmission line with a characteristic impedance of  $70.7\Omega$ . This is calculated as:

$$R = Z_0(N - 1)$$

where

$Z_0$  = system impedance ( $50\Omega$ )

$N$  = the number of outputs

The loss between the input port and either output port will be  $6dB$  for the divider with two output

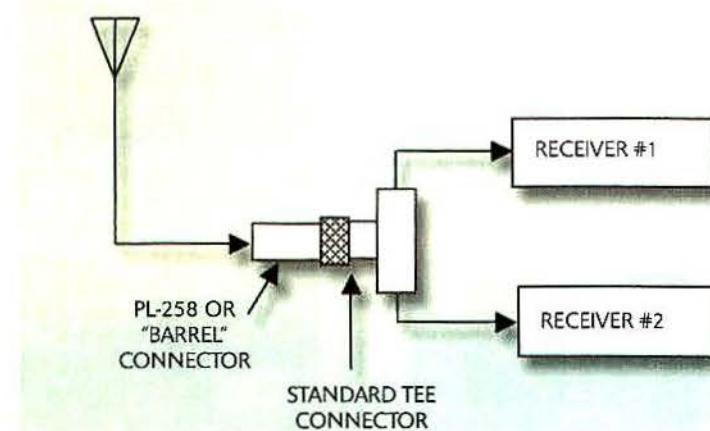


Figure 1. The simplest way to feed two receivers from a single antenna is to use the 'tee' connector arrangement shown here. It should only be used when isolation between receivers is not necessary and the signal level is adequate for division between the receivers.

### 'Tee' connector method

In the basic setup shown in Figure 1 above, we need to feed the inputs of two receivers from a single antenna. A simple "tee" connector is used to split the antenna line for each receiver input. This type of

of tee connectors required to provide  $N$  outputs is equal to  $N - 1$ .

### Resistive network method

Another simple method used to provide multiple outputs from a single source is the *resistive method*. The size of the resistors, such as in Figure 3 on page 32, is calculated as:

$$Z_0 = \sqrt{50Z}$$

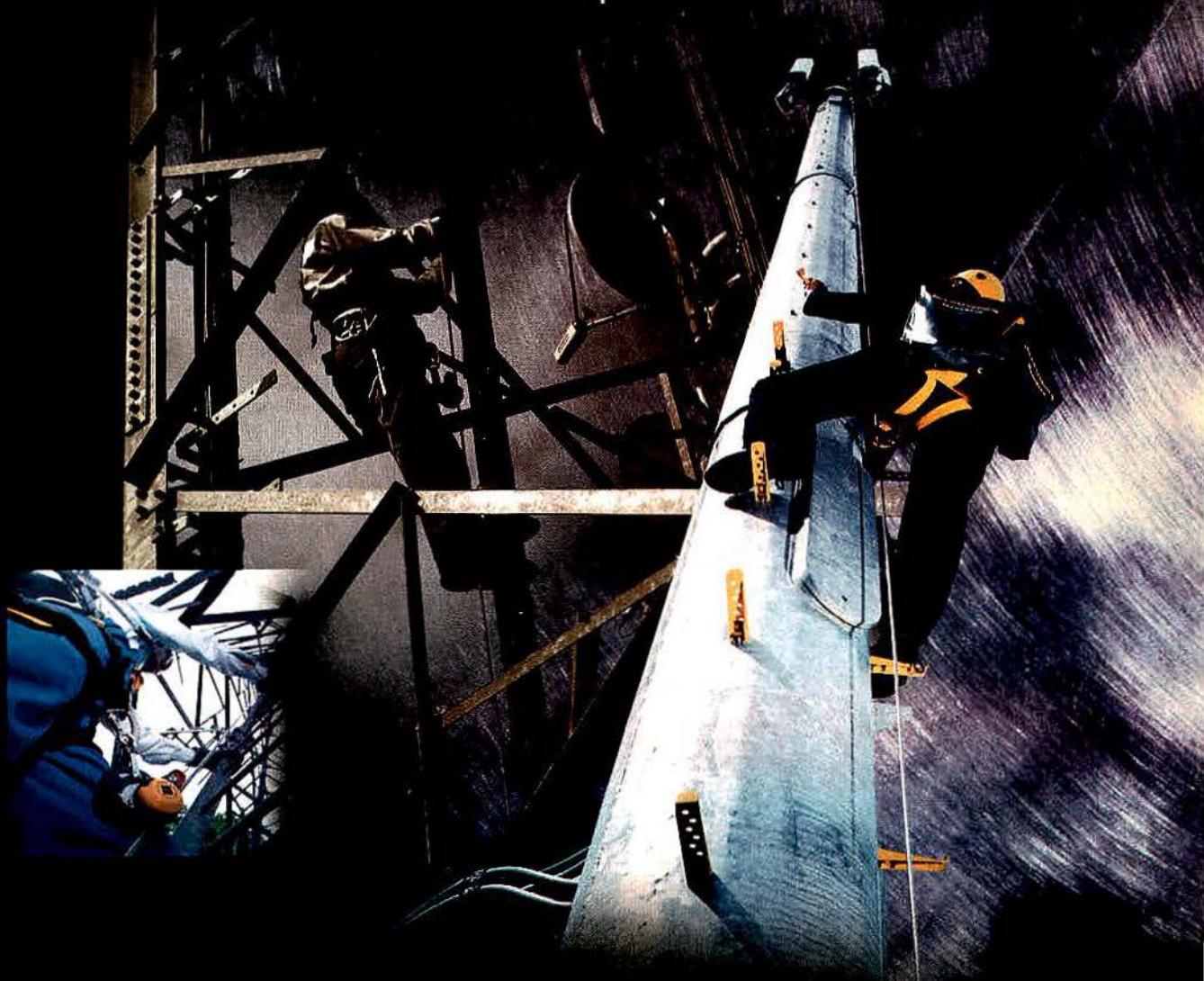
where

$Z_0$  = the characteristic impedance of the transmission line

$Z$  = the impedance to be transformed. This formula also can be rearranged as:

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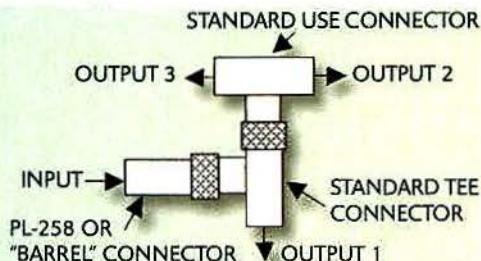


Figure 2. An input signal split three ways with two tee connectors. The number of tee connectors required is  $N-1$ , where  $N$  is the number of desired outputs.

$$Z = \frac{Z_o^2}{50}$$

This will provide the resultant impedance when using a quarter-wavelength section of transmission line of characteristic impedance,  $Z_o$ , on a device with a  $50\Omega$  impedance. Transmission lines with a characteristic impedance of  $70.7\Omega$  are not readily available, but  $75\Omega$  transmission lines are readily

available. So, substituting 75 into the formula we have:

$$Z = \frac{75^2}{50} = 112.5\Omega$$

This means that connecting a quarterwavelength section of  $75\Omega$  transmission line to an impedance of  $50\Omega$  will yield an impedance of  $112.5\Omega$  at the input, as shown in Figure 4 on page 34. This impedance of  $112.5\Omega$  is purely resistive, and it is properly written as  $112.5 \pm j0\Omega$ .

Now, to combine two  $50\Omega$  receiver inputs, we could use two quarter-wavelength lines, as shown in Figure 5 on page 34, to produce an impedance of  $56.25\Omega$  at the input to the tee connector.

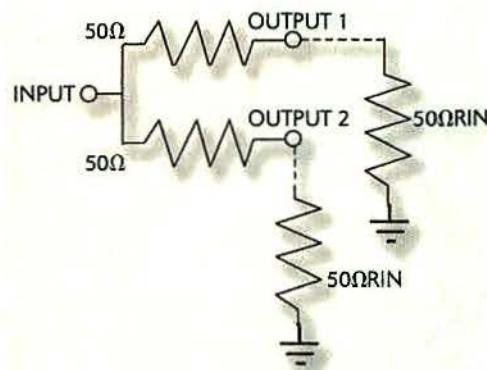


Figure 3. Two  $50\Omega$  resistors form a splitter network to feed two receiver inputs. The number of resistors needed to make such a resistive splitter equals the number of outputs needed. The value of the resistor is  $Z_o(N-1)$ , where  $Z_o$  is the system impedance ( $50\Omega$  for our purposes) and  $N$  is the number of outputs needed. For two outputs, we need  $50\Omega$  resistors in the divider network. The two  $50\Omega$  resistors shown connected to the outputs of the divider network represent the input impedance of the receivers.

This would produce a VSWR of 1.125:1—a good impedance match.

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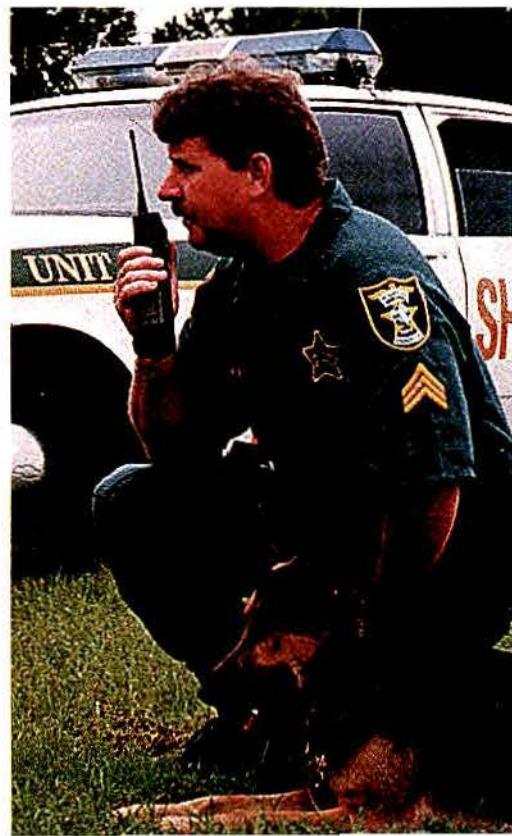
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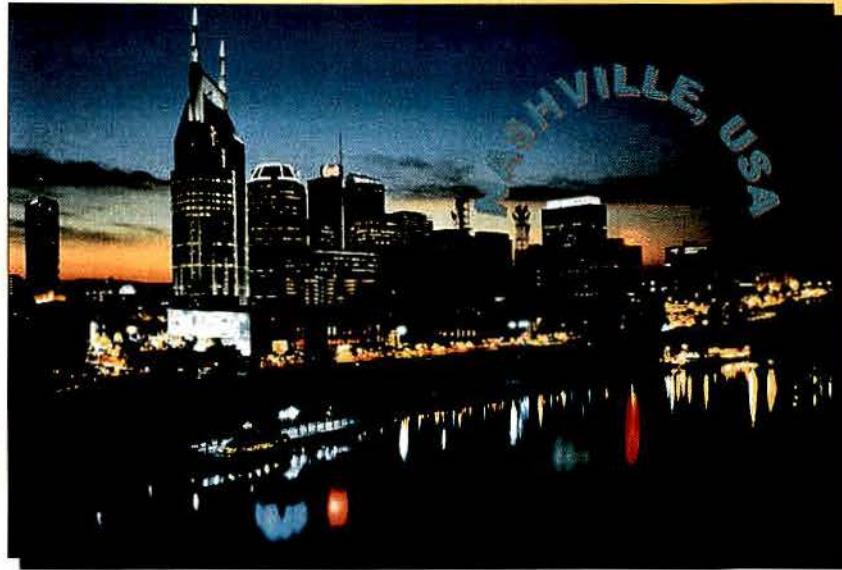
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## Preliminary Agenda

### **Wednesday, September 5, 2001**

6:00 p.m. - Opening Night Get-Together (unofficial)

### **Thursday, September 6, 2001**

7:00 a.m. - 8:45 p.m. - Continental Breakfast

7:00 a.m. - 5:00 p.m. - Registration

9:00 a.m. - Opening Session  
Chairman's Address

10:30 a.m. - Refreshment Break

10:45 a.m. - General Session

12:00 noon - Lunch

1:30 p.m. - General Session

3:00 p.m. - Refreshment Break

3:15 p.m. - General Session

5:00 p.m. - Adjournment

### **Friday, September 7, 2001**

8:00 a.m. - 5:00 p.m. - Registration

8:00 a.m. - 9:00 p.m. - Continental Breakfast

9:00 a.m. - General Session

10:30 a.m. - Refreshment Break

10:45 a.m. - General Session

12:00 noon - Lunch

1:30 p.m. - General Session

3:00 p.m. - Refreshment Break

3:15 p.m. - Closing Session

5:00 p.m. - Adjournment

### **Speakers To Date:**

Mark Crosby,  
*Spectrum Access, Inc.*  
Clark Madigan,  
*Westburg Media Capital*  
Eric Menge,  
*U.S. Small Business Admin.*  
K.C. Wright,  
*Centerpointe Towers*  
Jim Fryer,  
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CIRCLE (31) ON FAST FACT CARD



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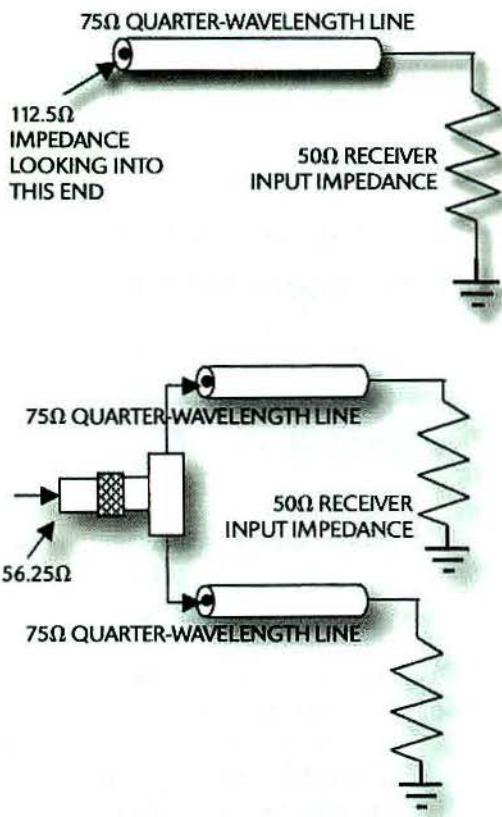


Figure 4 (top). A quarterwavelength of 75Ω transmission line transforms a 50Ω impedance into an impedance of  $112.5 \pm 0\Omega$  at the other end of the transmission line. Figure 5 (bottom). Two quarterwavelength 75Ω transmission lines provide an impedance match to a 50Ω system while splitting the input to two 50Ω receivers. The impedance 'looking into' the input side is 56.25Ω. It provides a close match to the 50Ω system impedance.

When cutting the transmission line to the proper quarterwavelength, it is necessary to account for the velocity factor of the transmission line. Remember, too, that *odd multiples* of quarterwavelength may be used, for practical purposes.

To divide the input into three outputs, quarterwavelength sections of RG-62 coax could be used. The characteristic impedance of RG-62 is 93Ω. Terminating it with the 50Ω receiver input will transform the impedance to 173Ω at the other end. Three of these connected

in parallel would produce an impedance of  $173 \div 3 = 57.6\Omega$  for a VSWR of  $56.6 \div 50 = 1.132:1$  at the input to the divider. This is close enough for practical purposes. Similarly, a 1:4 divider could be fashioned using four quarterwavelengths of RG-62. Because  $173 \div 4 = 43.25\Omega$ , this will produce a VSWR of  $50 \div 43.25 = 1.156:1$  at the input to the divider.

A commercially produced receiver multicoupler is the recommended way to go. Such multicouplers are usually designed as rack-mount units with a built-in preamplifier and hybrid power splitter, along with the necessary power supply. Dividing the input signal among several receivers will necessarily reduce the amount of signal level available at each output port.

For example, the *theoretical* insertion loss of a two-port divider is 3.0dB, for a three-port divider, 4.8dB, and for a four-port divider,



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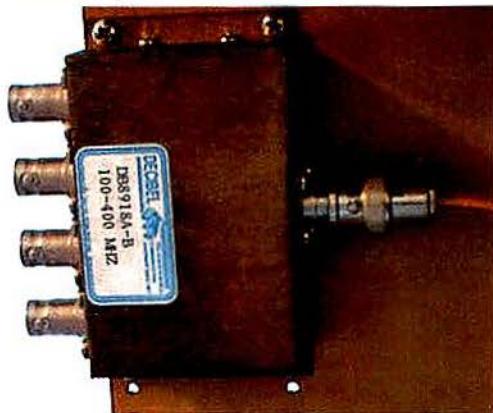
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A commercial-grade multicoupler unit.



A commercial multicoupler's signal divider is usually mounted on the back of the chassis.

6dB. In practice, the insertion loss will be greater than that, but it can never be *less* than that. Therefore, if you see an ad specifying inser-

tion loss *less than the theoretical minimum*, you can usually take that to mean that the insertion loss is that amount *plus* the theoretical minimum.

In commercial multicouplers, a low-noise preamplifier usually precedes the power divider, as shown in Figure 6 at the right. This will provide the best noise figure for the system. A high degree of isolation is also provided between the output ports for receiver-receiver isolation. When purchasing a commercial multicoupler, look closely at specifications such as: frequency range and bandwidth, receiver-receiver isolation, third-order intercept point, VSWR, system gain, noise figure, power requirements and preselector.

A commercial multicoupler unit includes a power supply and preamplifier, which are modular and can be easily removed for servicing. A signal divider is usually located on the rear of the chassis. A low-noise, high-gain preamplifier is used to overcome the losses of the

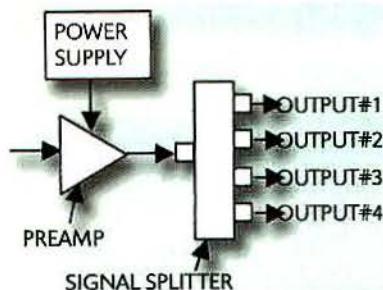


Figure 6. A typical receiver multicoupler provides a low-noise preamplifier preceding the signal divider. The amplifier should also have a high third-order intercept point for good IM rejection. The divider should provide a high degree of isolation between output ports. Any unused output port should be terminated in a  $50\Omega$  impedance.

divider while maintaining a low noise figure.

Homemade signal dividers might be useful in a given situation, such as an emergency. However, to maintain a system with optimum performance, use a commercial-grade multicoupler unit.

Until next time—*stay tuned!* ■

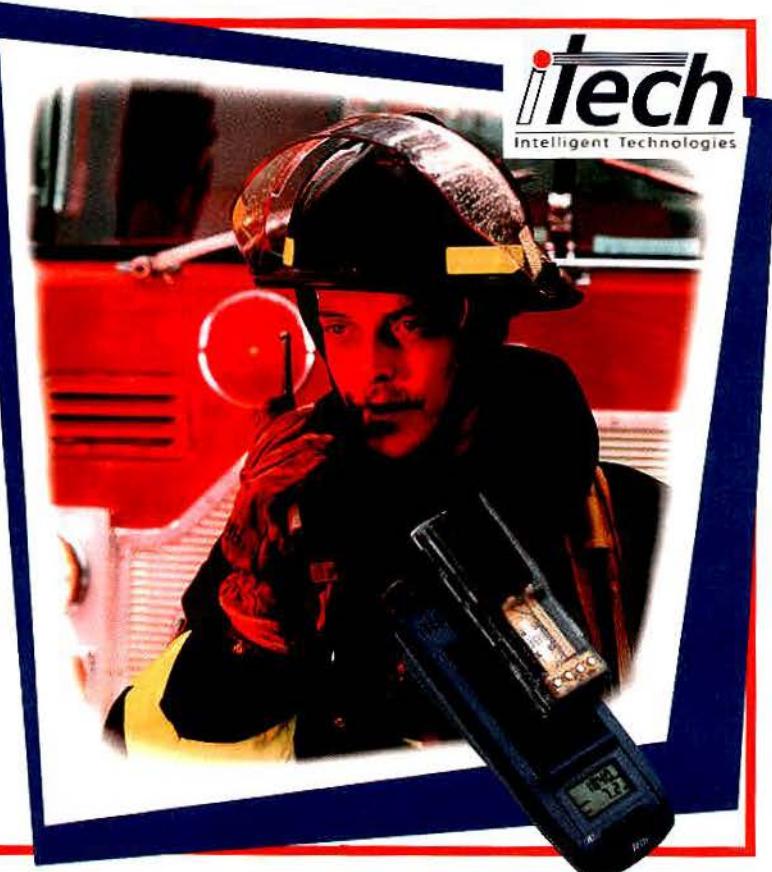
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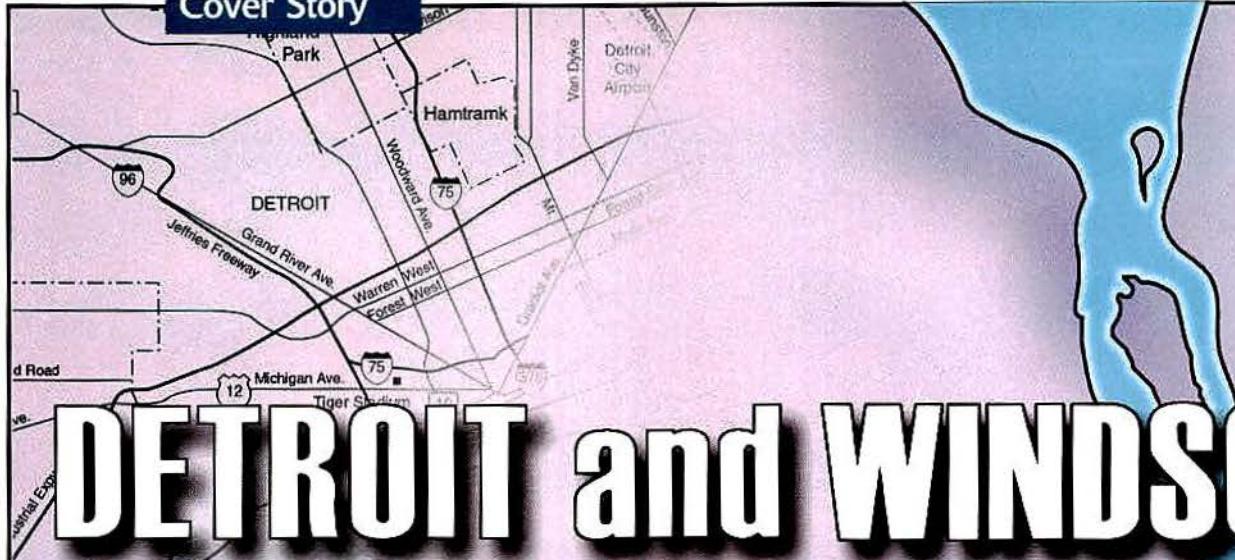
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CIRCLE (35) ON FAST FACT CARD

Cover Story



# DETROIT and WINDSOR

A TALE OF TWO CITIES AND THEIR PUBLIC SAFETY NETWORKS



A Windsor dispatcher receives an emergency call.



Windsor's communications center.



Windsor's emergency communications system provides dispatching services to the city and surrounding municipalities. The computer dispatch system includes CAD and a radio console.

## Interoperability problems can mean difficulties talking inside your own house as well as with the people next door.

By James Careless

**D**etroit and Windsor: Separated geographically by the Detroit River and politically by the U.S.-Canadian border, these two cities have grown cheek-by-jowl for the past 200 years. Yet, despite their proximity, these Michigan and Ontario cities are two different—and separated—places.

For one thing, Detroit's municipal population is nearly one million. Windsor is actually the 15th largest city in Canada, but its population still numbers less than 300,000 souls, making it a small city by U.S. standards. Another difference is that Detroit is one of America's major urban centers, whereas Windsor has traditionally lived in the shadow of its bigger U.S. sister city.

Then there are the public safety radio networks. Detroit and Windsor differ widely in this aspect as well. In fact, you can literally say that they're not on the same wavelength.

### Detroit: Established network

Public safety radio is no modernism in Detroit. In fact, Detroit Police Commissioner William Rutledge began testing radio-equipped patrol cars back in 1921. In those early days of radio technology, Detroit's police cars were only equipped with one-way receivers. Still, when it came to fast dispatch, one-way broadcasts from headquarters were a vast improvement over no broadcasts at all.

According to the *Detroit News*, this early public safety network had its own unique problems. For instance, the radios' delicate vacuum tubes had to be housed in padded cases. Also, the cars'

electrical systems weren't strong enough to power these 6V units, so external batteries had to be mounted on the cars' running boards. To make life more complicated, those batteries only lasted for four hours, at best.

Then there was the issue of the Detroit Police broadcast station, which was licensed on the AM band. Because of that band position, the headquarters-based station, "KOP," frequently ran afoul of the Federal Radio Commission, the forerunner of the FCC. The FRC insisted that KOP air "entertainment during regular hours, with police calls interspersed as required." In response, Commissioner Rutledge replied, "Do we have to play a violin solo before we dispatch the police to catch a criminal?"

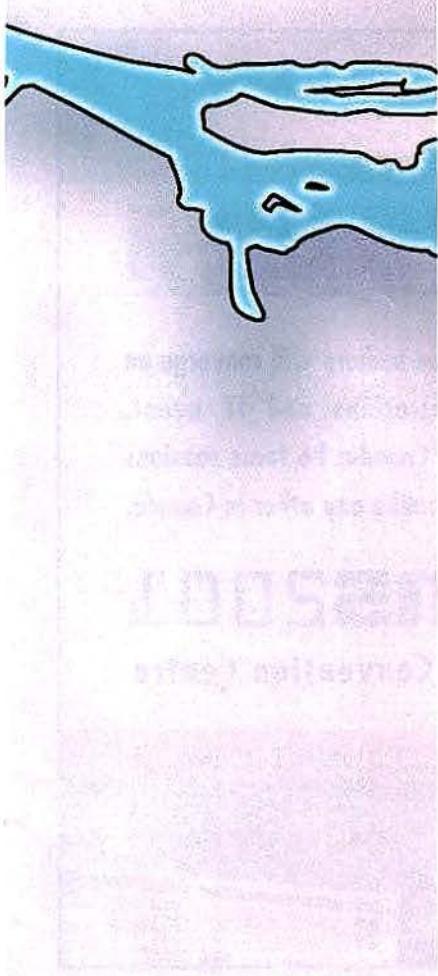
Times have changed. Since going full-time in 1922, Detroit's public safety networks have grown in size and scope. Today, they serve "every city department except the Department of Transportation," said Lt. Michael Terrell, the Detroit Police's senior supervisor of radio maintenance technicians. "This means we cover police, fire, EMS, the water board, certain hospitals, boats, city engineers, animal control and the zoo."

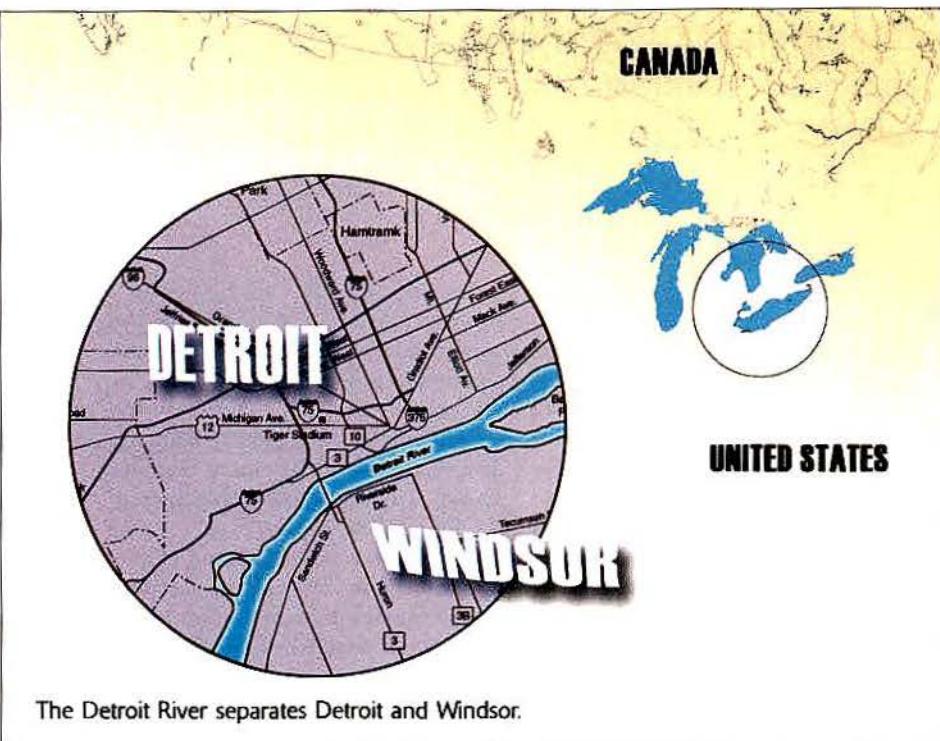
To do this, Detroit operates multiple transmitter sites throughout the city, Terrell noted. The city also runs a maintenance facility at Belle Isle to repair its Motorola and Ericsson mobiles and portables.

However, the integrated approach

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Careless is a freelance telecommunications journalist based in Ottawa, Ontario, Canada. His email address is [james@tjtdesign.com](mailto:james@tjtdesign.com).





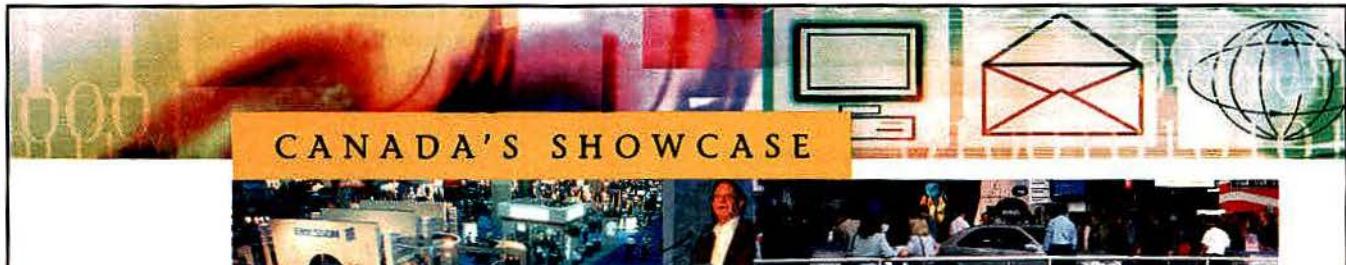
The Detroit River separates Detroit and Windsor.

doesn't mean that everyone can push a button and talk to everyone else. Different departments are on different bands. For instance, the Detroit Police operate two 400MHz UHF networks and an 800MHz trunking system, Terrell said. However, the city's fire department and EMS operate in the VHF highband, while the water board uses lowband VHF and 800MHz trunked communications.

Departmental interoperability has yet to be achieved. There are no links between these networks yet so that police can talk to fire, and so forth. In general, each department tends to rely on its own dispatch center and its own people.

#### Windsor: New network

In contrast, the Windsor's public safety network is all about integration. That's because in 1996 the



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**CIRCLE (37) ON FAST FACT CARD**

city's police, fire and public works departments took a look at their aging, separate systems and decided to combine them into one 800MHz trunked network.

The result? Today everyone—except EMS, which is still on an older VHF network—can talk to each other during emergencies. The Windsor city network even has a common channel open to all services, said Italo Carducci, director of emergency communications for Windsor Fire & Rescue. In times of crisis, this common channel can bring everyone up to speed in a hurry.

A case in point was a November 2000 maintenance tragedy at the cross-river Ambassador Bridge. One painter drowned when an under-bridge scaffold suddenly collapsed. Two other painters fell into

the river, and four more were left dangling by their safety harnesses.

As it turned out, "The first call we received was from a public works truck driver passing by, who saw these people hanging and call-

ed us for help," said Carducci. Thanks to the common channel, all services, except EMS, heard the call as it came in, thus saving precious response time. (In fact, except for the first drowned man, all the other painters were successfully rescued.)

Windsor Fire & Rescue is currently operating on a Motorola 800MHz network using 12 channels, with MPS-2000 and Spectra mobiles deployed in the field. Like Detroit, the network operates using three towers strategically placed across the city, with services coordinated through the Windsor Fire & Rescue Communications Division.

When will the system include Windsor EMS? The only reason it is separate now is because the Ontario provincial government, not the city, operates the ambulance service, Carducci said. Windsor Fire & Rescue does maintain dedi-

cated telephone links to help EMS stay in touch with everyone else.

### Differing challenges

Obviously, two such different cities have different challenges when it comes to public safety networks. For Detroit, the challenge is its aging 400MHz technology.

"Four hundred megahertz has been a real workhorse for us," said Detroit Police Inspector John Mlynarczyk. "It does the job we need done in the field today. However, it's an ongoing task to keep this technology maintained and functioning."

As a result, Detroit is considering buying a new 800MHz system and following Windsor's example by creating an integrated communications network. The price tag isn't cheap, said Mlynarczyk. "In fact, it's about \$50 million to \$60 million, which makes it a major expense. However, the benefits of 800MHz, with its trunking capabilities, would offer a lot of benefits to all of us, and go a long way to justifying this expense."

Meanwhile, even with its new 800MHz network, Windsor has problems of its own.

"Our biggest challenge is to ensure that the technology runs smoothly," Carducci said. "We're running a three-site simulcast, so it's important that everything runs as it's supposed to."

### Two solitudes, radio-wise

So, what about *cross-jurisdiction* interoperability? With two differing radio systems, how do the adjacent cities of Detroit and Windsor work together? The answer depends on whom you talk to. For instance,

neither Mlynarczyk nor Terrell can remember Detroit Police ever coordinating radio communications with Windsor.

"We tend to work our own turf," Mlynarczyk explained. Ground access between the two cities/countries is limited to the Ambassador Bridge and the Detroit-Windsor Tunnel, both of which are toll facilities and therefore unlikely spots for a high-speed chase to cross jurisdictions.

However, the situation is different for Windsor Fire & Rescue. "We quite often work with the Detroit Fire Department," Carducci said. "For instance, we both respond to the Windsor Tunnel." (The DWT runs under the Detroit River to link the cities.) "As well, since we don't have a fireboat, they help us out on the Detroit River whenever something happens on our side."

So how does Windsor talk to Detroit, and vice versa? Sometimes the simplest solution presents itself. "We've overcome the problem by lending each other a few radios," answered Carducci. "In this way, when we need to talk to each other, we can."

### A more connected future?

So what will happen when all of Detroit's agencies migrate to 800MHz trunked technology? One can only guess. However, it seems reasonable to expect that, once Detroit and Windsor are in the same bandwidth and using the same technology, they'll begin talking to each other on a regular basis. But until that day, these two adjacent cities' public safety networks remain as separate as those of Los Angeles and Toronto.



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CIRCLE 138 ON FAST FACT CARD

# HOW RADIO WAVES ARE BORN

By Jim Hawkins

**O**ne of the least-understood phenomena in electrical engineering is how electric and magnetic fields allow a transmission antenna to form what we know as radio waves. This overview (which makes certain assumptions to eliminate the need for calculus) describes how electromagnetic fields behave to provide propagated radio signals. (An expanded version can be found at [www.jphawkins.com/radio.shtml](http://www.jphawkins.com/radio.shtml) or at MRT's Web site at [www.mrtmag.com](http://www.mrtmag.com).)

The electromagnetic field equations developed by 19th-century physicist James Clerk Maxwell lead us to begin with the premise that a changing magnetic field causes the existence of an electric field, and a changing electric field causes the existence of a magnetic field. We move from there to establish that electromagnetic waves can exist in space without the presence of a conductor. Finally, based on these two phenomena, the transition from conduction electromagnetic fields (those bound to the conductor) to those existing in free space becomes apparent, as well as the mechanism of propagation of these fields as waves.

#### Changing magnetic fields creates electric fields in space

In a straight wire, the total voltage can be calculated by multiplying the electric field intensity that is parallel to the wire by the length of the wire:

$$V_c = E \times L$$

where

$L$  = the length of the wire (m)

$E$  = electric field strength (V/m)

$V_c$  = the resulting potential between the ends of the wire (V)

To find the relationship of the total voltage to the magnetic flux density  $B$ , we use Faraday's Law, which states that the voltage induced in a loop of wire is directly proportional to the number of magnetic flux lines, (measured in Webers) passing through the wire per unit of time. So, the number of volts is proportional to Webers per second.

If we assume that all the flux lines are perpendicular to the wire, we can write that the total flux, in Webers, is  $B \times A$ , where  $B$  is the flux density in Webers/m<sup>2</sup> and  $A$  is the area in square meters. To express this in terms of Faraday's Law, let's say that the flux density changes from  $B = B_0$  to  $B = B_1$ . We express the voltage developed as the flux changes from time "0" ( $t_0$ ) to time "1" ( $t_1$ ) as:

$$V_c = A(B_1 - B_0) \div (t_1 - t_0)$$

Taking the voltage due to the electric field,  $E$ , and substituting, we now have:

$$E \times L = A(B_1 - B_0) \div (t_1 - t_0)$$

which is the mathematical equivalent to the statement that a changing magnetic field,  $B$ , will create an electric field,  $E$ , in space.

#### Create a magnetic field in space

The idea of *displacement current* is the key to developing

Hawkins, a writer in Middleton, NJ, with a background in electrical engineering and computer science, develops fiber-optic test-and-measurement software for Tycom Laboratories, Eatontown, NJ. He is a member of the Radio Club of America. For more detailed information on this subject, visit his broadcast technology Web site at [www.jphawkins.com/radio.shtml](http://www.jphawkins.com/radio.shtml).

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a mathematical explanation that a magnetic field is born out of a changing electric field in space. Displacement current is an abstract idea that there is an electric current flowing in space. By assuming that a "current is flowing," certain assumptions can be made to de-

velop the necessary equations. (For more on the development of the displacement current concept, see the previously referenced Web site.)

First, we introduce *dielectric displacement*,  $D$ , which represents the electrical strain that occurs in a dielectric medium, when an electric

field is present:

$$D = \epsilon E$$

$$B = \mu H$$

$D$  is analogous to magnetic flux density,  $B$ ; hence  $D$  is really the *electric* flux density. It is related to the electric field by  $\epsilon$ , which is the *permittivity*, or dielectric constant, of the material between the plates of a capacitor. The magnetic flux density,  $B$ , is related to the magnetic field strength,  $H$ , by  $\mu$ , which is the permeability of the material within the magnetic field.

A capacitor is a useful model to explore the displacement current concept. When a voltage is applied to the leads of an uncharged capacitor, a current flows until the capacitor is fully charged. What is happening between the plates of the capacitor (that, for this example we assume is filled with space)?

First, as current flows into the capacitor, an electric charge accumulates on the plates, with excess electrons on one plate and positive ions on the other. As the charge builds up, an electric field,  $E$ , builds between the plates, causing the dielectric displacement, or electric field density, to also increase. To satisfy Kirchoff's law (the total current flowing *into* a volume must flow *out of* the volume), there must be some sort of current flowing in the dielectric, and it must be proportional to the rate of change of dielectric displacement. This current is called *displacement*. We can think of it as an inflow (displacement) of additional flux, as required, as the electric flux density increases. This total displacement current equals the conduction current flowing into and out of the capacitor.

Maxwell made the assumption that a magnetic field was associated with the displacement current. In considering this, he developed the following relationship, assuming that the displacement current is perpendicular to the area and the area is flat:

$$H \times L = A (D_1 - D_0) \div (t_1 - t_0)$$

where

$A \times D$  = the total flux across the capacitor space

$$(D_1 - D_0) \div (t_1 - t_0) = \text{the change in}$$

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flux density with a change in time.

The displacement current is the rate of change of the electric flux across the capacitor space.

### We have radiation

We have finally arrived at two simplified versions of the principal field equations of Maxwell:

$$E \times L = A(B_1 - B_0) \div (t_1 - t_0)$$

$$H \times L = A(D_1 - D_0) \div (t_1 - t_0)$$

If we make the substitutions from  $B = \mu H$  and  $D = \epsilon E$ , we have the following non-calculus simplification of Maxwell's free-space equations:

$$E \times L = \mu A(H_1 - H_0) \div (t_1 - t_0)$$

a changing magnetic field,  $H$ , will produce an electric field,  $E$ , and

$$H \times L = \epsilon A(E_1 - E_0) \div (t_1 - t_0)$$

a changing electric field,  $E$ , will produce a magnetic field,  $H$ .

These equations are the keys to electromagnetic radiation. Most important is the fact that no conduction current need exist and, therefore, no physical conductor is required.

### The concept of radiation

The concept of radiation, therefore, can be described as: *If there is an alternating current in a conductor, an alternating magnetic field will be created surrounding the wire. The alternating magnetic field, due to the current in the wire, will create an alternating electric field in space farther out from the conductor.*

We have liftoff. The first transition from conduction fields to space fields has been made. Carrying it further, the alternating electric field, which was just born in space, will create a magnetic field (due to the corresponding displacement current in space) farther away from the conductor. The alternating magnetic field will then create another alternating electric field. This process, which continues on away from the conductor, is called electromagnetic wave propagation, and that gives us *radio*.

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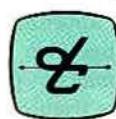
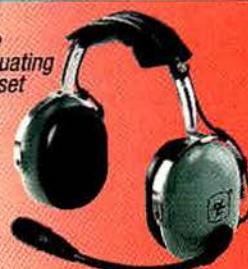
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T-5

CIRCLE (41) ON FAST FACT CARD

MOBILE RADIO TECHNOLOGY

47

# How's your antenna?

Familiarity with antenna characteristics helps predict performance in matching the right 'stick' to the right application.

By Patrick E. Buller

To the casual observer, it's just a wire or just some sort of metallic nuisance that needs painting. We recognize it as an antenna, a metallic device, such as a rod or wire, for radiating or receiving radio waves. An antenna is most efficient when its physical length is appropriate for the frequency to be operated. The physical length is determined by its relation to *wavelength* ( $\lambda$ ), which in turn is related to the speed of light.

The velocity of light,  $V$ , is roughly 186,000 mi/s. Multiplying  $V$  by 5,280 ft./mi. yields  $984 \times 10^6$  ft./s. *Megahertz* is a million events per second. One wavelength is also one hertz, which is also equal to one period of events per second. Therefore, 984,000,000 divided by frequency equals one wavelength ( $1\lambda$ ).

One wavelength =  $984 \div F(\text{MHz})$ . For the  $\frac{1}{2}\lambda$  dimension, in feet, 492 is the value to be divided by the frequency, and  $492 \div F(\text{MHz}) = \frac{1}{2}\lambda$ , in feet.

Example:  $984 \div 155\text{MHz} = 6.35\text{ft.} = 1\lambda$ .

$$\frac{1}{2}\lambda = 3.175\text{ft.}$$

$$3.175\text{ft.} \times 12 \text{ in./ft.} = 38.1\text{in.}$$

$$\frac{1}{4}\lambda = 19.05\text{in.}$$

All of the above is relative to the speed of light. If we are going to use wires or conductors of any type as the antenna, then things take on a different characteristic. Anything other than free space will slow down energy, and the ratio of free-space travel to conductor travel is the *velocity factor*, usually noted as  $v_p$ .

The *isotropic antenna* is a fictitious antenna, also called the *point source*. It is analogous to a bare flashlight bulb theoretically illuminating a room evenly. When the flashlight bulb is placed at the focal point of a parabolic reflector, a light beam is formed. The difference in the light observed at the center of the parabolic beam and that of the bare bulb is *gain*. This comparison relates directly to microwave antennas that use a parabolic dish. In fact, microwave antennas are compared to the isotropic antenna, and all gains are written as units of *dB<sub>i</sub>*, meaning decibels relative to a hypothetical isotropic antenna.

By definition, the *dipole antenna* is a  $\frac{1}{2}\lambda$  conductor, with energy supplied in the center, as shown in Figure 1 on page 49. It is a balanced-feed device, and its parameters are measured or compared at a height above ground of  $\frac{1}{4}\lambda$ . Its gain, compared to the isotropic antenna, is 2.15dB<sub>i</sub>. This antenna is easily built and calibrated, and it is the standard antenna for measurements of frequencies below 900MHz. Antennas with non-dBi gain figures are given in units of *dBd* (i.e., referenced to the dipole). Figure 2 on page 49 shows the voltage and current relationship of a  $\frac{1}{2}\lambda$  dipole antenna.

Let's look at an antenna for its feed point impedance over several wavelengths. Keeping the physical length constant, the frequency will be changed and the base impedance measurements can be taken and the results plotted as shown in Figure 3 on page 49. A horizontal line that represents  $0\Omega$  resistance at the left

and approaches infinity at the right represents the resistance. Inductive reactance lies above the horizontal line, and capacitive reactance lies below.

In the electronics world, we like to have everything resistive. So, looking at the spiral, we determine that if we operate at the point where the spiral line crosses the resistive line, the antenna would then be *resonant*. (The energy boys call this point *unity power factor*.)

So, is the free-space formula in error? Not really, it just needs some modification. In reality, the frequency that provided this zero reactive point was plugged into the formula to find a "K" factor that would modify the free-space formula,  $492 \div F(\text{MHz})$ , to bring us to the zero point. That "K" factor is 0.95 for wire antennas up to about 30MHz. Beyond 30MHz, the diameter of the wire also affects the overall length for a pure resistive impedance. The result is the classic  $468 \div F(\text{MHz})$  seen in most text books for a  $\frac{1}{2}\lambda$  antenna.

Figure 4 on page 50 shows the impedance spiral of a  $\frac{1}{2}\lambda$  antenna cut to the dimensions of  $468 \div F(\text{MHz})$ . Again, this is only good for wire antennas or thin elements for the lower frequencies and at  $\frac{1}{4}\lambda$  above ground. The lower the antenna is to ground, the lower this impedance will become. A rule of

Buller is a special projects engineer for Tacoma Power, Tacoma, WA. For many years he served as an electronics design engineer for the Washington State Patrol. He is a member of IEEE, NARTE, APCO and ARRL, and he is a Fellow of the Radio Club of America. His email address is W7rqt@msn.com.

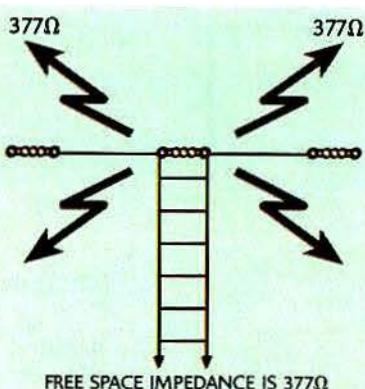


Figure 1. An antenna is a special case of a terminated transmission line.

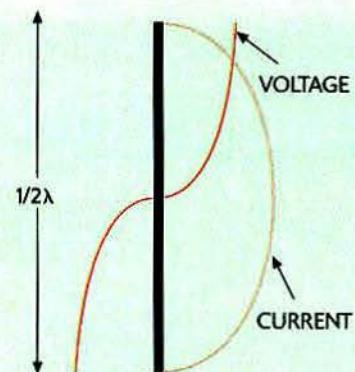


Figure 2. Voltage and current relationship of a  $\frac{1}{2}\lambda$  antenna.

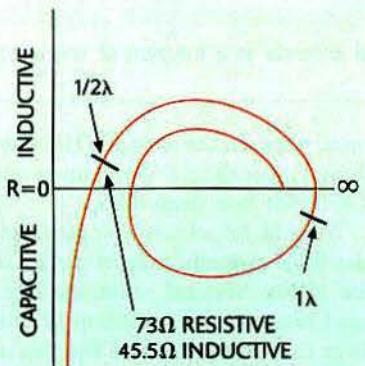


Figure 3. Impedance spiral of  $\frac{1}{2}\lambda$  antenna. Free space dimension  $492 \div F(\text{MHz})$ .

thumb is if the antenna is about  $\frac{1}{8}\lambda$  above ground, the impedance will measure somewhere around  $50\Omega$ . In the amateur radio band, this means an 80m antenna up 30' will closely match the magic number of  $50\Omega$ . Also note that the antenna has a higher impedance in the center if it is  $1\lambda$  long. At  $\frac{3}{4}\lambda$ , the center impedance is again low.

That means a center-fed antenna can and will operate on the 3rd harmonic. Examples would be a  $\frac{1}{2}\lambda$  on 7MHz and a  $\frac{3}{4}\lambda$  on 21MHz.

Figure 5 on page 50 shows the impedance spiral of a  $\frac{1}{4}\lambda$  antenna cut for free-space dimensions. Note that the numbers are exactly one-half of the  $\frac{1}{2}\lambda$  dipole:  $Z_0 = 36 \times$

$j21\Omega$ . Again, the element must be shortened to yield pure resistance, using the same formula except  $\frac{1}{2}$  of the total length. The only difference between this antenna and the dipole is that the ground plane is considered infinite in length. In reality, it need only be  $\frac{1}{2}\lambda$  diameter in all directions. The  $\frac{1}{4}\lambda$  antenna is a low-

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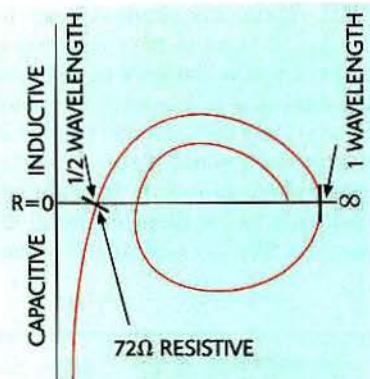


Figure 4. Impedance spiral of a  $1/2\lambda$  antenna shortened by  $K=0.95$  or length= $468+F(\text{MHz})$ .

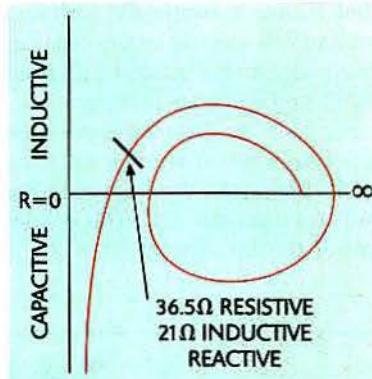


Figure 5. Impedance spiral of a  $1/4\lambda$  antenna free space dimension  $492/F(\text{MHz})$ .

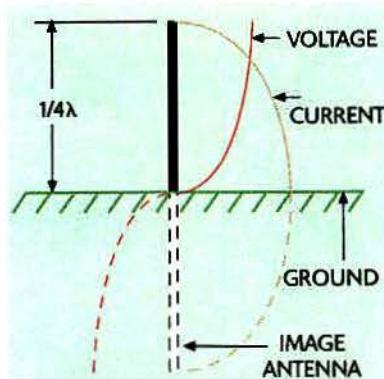


Figure 6. Voltage and current relationship of a  $1/4\lambda$  antenna.

impedance, or current-fed, antenna, as shown in Figure 6 above. It has a voltage minimum at the feed point and again at the  $\frac{3}{4}$  point. Advantages of a  $\frac{3}{4}\lambda$  antenna are that the impedance can be near  $60\Omega$  (a better match than the  $\frac{1}{4}\lambda$ ), and a minor lobe

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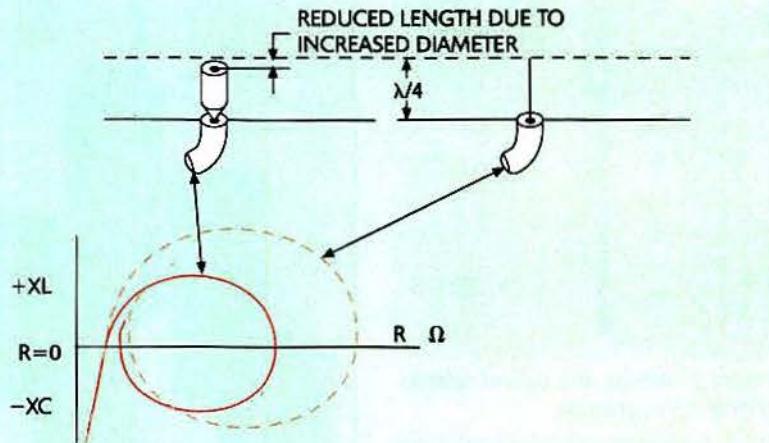


Figure 7. Impedance spiral of a  $\lambda/4$  vertical antenna as a function of conductor diameter often referred to as *bandwidth*.

appears above the horizon, which is helpful with radiation to higher sites.

Figure 7 shown above amplifies another consideration of the radiating element. Large diameters lower the antenna's quality factor, or "Q." In other words, it makes it a broadband device. There is a larger spread of frequencies with which the antenna will operate with acceptable standing wave ratio. This is primarily due to the amount of capacity added because of the increased area. To keep the antenna resonant, the conducting element must be shortened to compensate for the added capacity. This brings the topic of the ratio of diameter of radiating element to wavelength dimensions, as shown in Figure 8 on page 51. In other words, the "K" factor is the determinate when the antenna element is larger than a

small wire. In the case of VHF, anything larger than a  $1/8$  rod must use a K factor less than 0.95.

The AM broadcast industry first identified antenna characteristics in the 1920s. Vertical antennas were used because the radiation is uniform from the center of the tower. Dipole antennas have directivity, with nulls at the ends of the conductor. The broadcasters' interest was to obtain the most signal strength, so the vertical antenna underwent a series of tests to determine the optimum height. Figure 9 on page 51 graphs signal strength measured with different vertical antenna heights and 1kW of power. Note that maximum power is received with the antenna at  $0.625\lambda$ , and almost nothing at one wavelength.

Figure 10 above graphs a side view of radiation with different

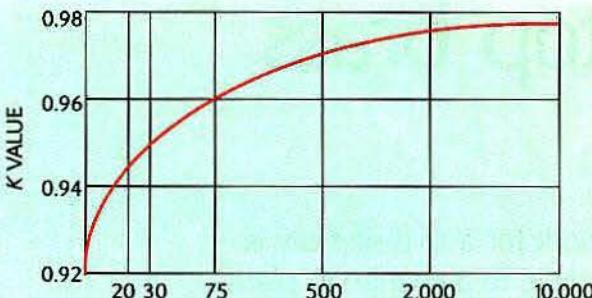


Figure 8. Ratio of halfwavelength to conductor diameter—same units.

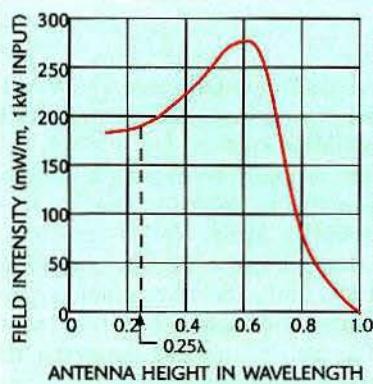


Figure 9. Plot of field strength vs. vertical antenna length.

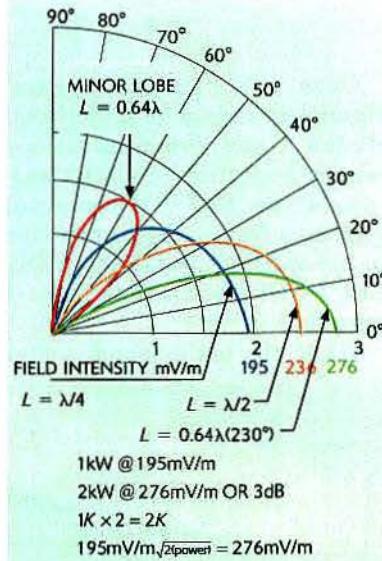


Figure 10. Vertical plane patterns for three values of antenna height. Field intensity is millivolts per meter.

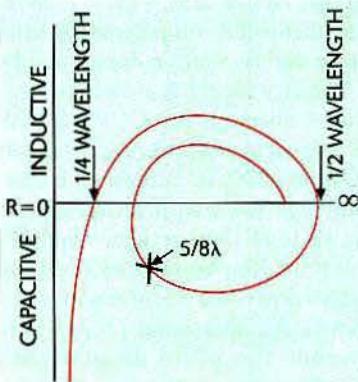


Figure 11. Impedance spiral of a vertical antenna. Note low resistance and capacitive reactance. Series inductance cancels. This is how the Larsen mobile  $5/8\lambda$ , 3dB gain antenna came about.

antenna heights. At the  $5/8\lambda$ , you can see there is a minor lobe beginning at the  $75^\circ$  point, that gets somewhat larger at  $3/4\lambda$  (not shown). Installing a  $3/4\lambda$  antenna is an attractive prospect for vehicles because this antenna not only radiates in the horizontal but also has an elevated signal that can bounce off buildings. The  $3/4\lambda$  is particularly effective for motorcycle

radios using the VHF band. The impedance of a  $3/4\lambda$  vertical is closer to  $50\Omega$  than the  $1/4\lambda$  antenna.

The late James L. Larsen, founder of Larsen Antennas, introduced the  $5/8\lambda$  antenna for mobile use by incorporating a coil at the feed point that cancels the capacitive reactance, leaving the antenna just above  $50\Omega$  resistive. It is marketed as the 3dB gain VHF antenna.

Another example of antenna impedance vs. height is shown in Figure 11 above. Any multiple of  $1/2\lambda$  results in high impedance, sometimes referred to as *voltage feed*. Multiples of  $1/4\lambda$  are referred to as *current feed*.

It should be pointed out that even a small piece of wire is a high-impedance device, if it is measured with an ohmmeter. It is only low resistance when it's employed as a resonant device. ■

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# Satisfying the top brass

Modernizing the communications network for a mid-size city is a lot easier when the vendors are adaptable to a change in plans.

By Don Bishop

Waterbury, CT, could have been expected to want to emphasize "polish" in executing a communications systems overhaul. A metalwork-manufacturing center for generations, Waterbury is often referred to as the "Brass Capitol of the World." The people with the brass badges who serve and protect the population,

Over the past two years, Waterbury's range of projects included a new communications center, a citywide 800MHz system, a new CAD/RM computer system, a frame-relay connection to the state of Connecticut COLLECT/NCIC and a new E9-1-1 telephone system.

While the old dispatch center

readied new Orbacom radio consoles to manage the new citywide 800MHz system. On June 6, the city formally accepted the system supplied by Johnson. The two-site, 800MHz Multi-Net II simulcast trunked radio system supports 1,000 units, including mobiles, portables and mobile data terminals. The police and fire departments have been integrated into the citywide 800MHz system, which also serves the street, water, education, sewer and waste, central maintenance, engineering, and parks and recreation departments.

The city received aid on its CAD project through the COPS MORE 98 federal grant program. The new COLLECT/NCIC computer frame-relay system was interfaced with the state of Connecticut's computers, providing Waterbury's officers with improved information retrieval. An additional project is to upgrade the police department's vehicle mobile data computers.

Lt. Gary Stango, commander of communications, records, property and IS divisions for the Waterbury Police Department, said that he was impressed with the work performed by Johnson on the radio system since the contract was let in March 1999.

"There are bugs in any system, and when you begin construction, it can be necessary to vary from the paper plan," Stango said. "Johnson was attentive to our needs. They worked hard; they were here; and



The renovated Waterbury Police Department's communications center features 10 interchangeable positions for call-takers, dispatcher and supervisors. For the first time, dispatchers can interoperate with every police and fire department in six nearby towns in the Naugatuck Valley. Projection screens show law enforcement calls as they come in.

the Waterbury Police Department, have been implementing far-reaching goals for improvements to their communications capabilities.

was being completely gutted and renovated, the E. F. Johnson Company subsidiary of Lincoln, NE-based Transcrypt International

they made whatever modifications were necessary to complete the new system and make the transition from our previous system."

Using NPSPAC frequencies that were identified in 1994 and licensed after a lengthy process ending in 1998, the system uses trunking for voice communications and a dedicated frequency for mobile data. Johnson installed the mobile-data system, which was supplied by Atlanta-based Dataradio.

"I put public utilities on the system first," Stango said, detailing the rollout. "We started with street, water, refuse and all other non-emergency departments to help test the system. That's where we worked the bugs out. Next to be cutover was the fire department. The police department has been on the system since July 2000."

#### The consultants

Radio Communications Associates of East Granby, CT, provided consulting services for the project and wrote the bid. RCA's owner, Robert Fairbairn, praised Johnson's involvement.

"During construction, many things came up that weren't Johnson's problem, but they had to resolve them for us. In those cases, they were very helpful. In my 36 years in the business, I've never dealt with a vendor that was so good. Their project managers were their strength. There was nothing done that was an effort to glaze over the fact that something didn't work," Fairbairn said.

"I've dealt with all of the other manufacturers, and I really have to commend Johnson. Waterbury was a big project involving much more than just the radio system, and the logistics of putting the center together created some of the problems that they helped to resolve," Fairbairn said.

Michael E. Jalbert, Transcrypt's chairman, commented: "We are pleased to be a part of the team that has brought state-of-the-art communications equipment to the city of Waterbury. As a result of the collaboration between E. F. Johnson

The Waterbury system has two tower sites and 90% coverage from each one. The Long Hill site, shown here, shares a location with other towers including private and common carriers. From Long Hill, microwave links surrounding towns in addition to the other site and police headquarters.

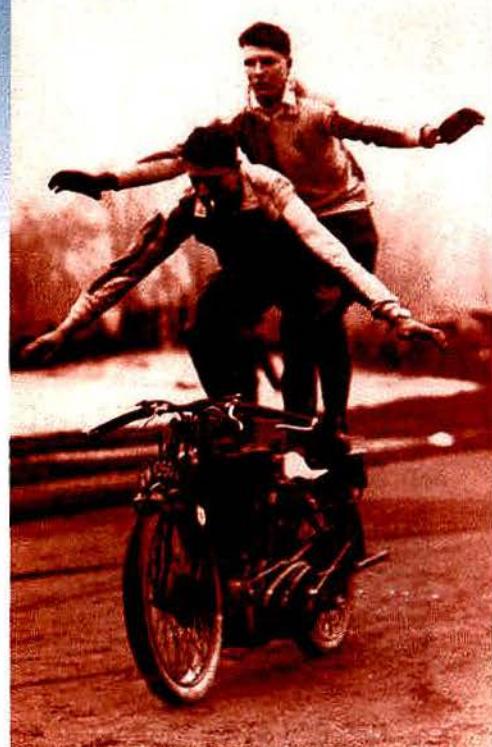


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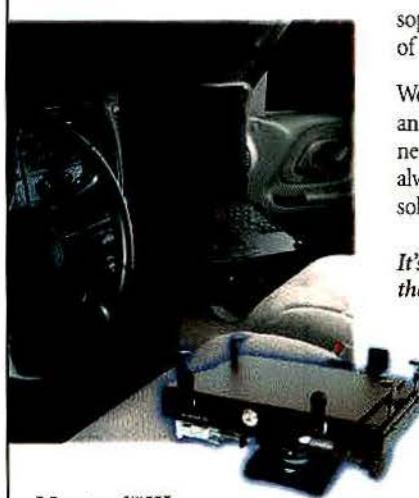
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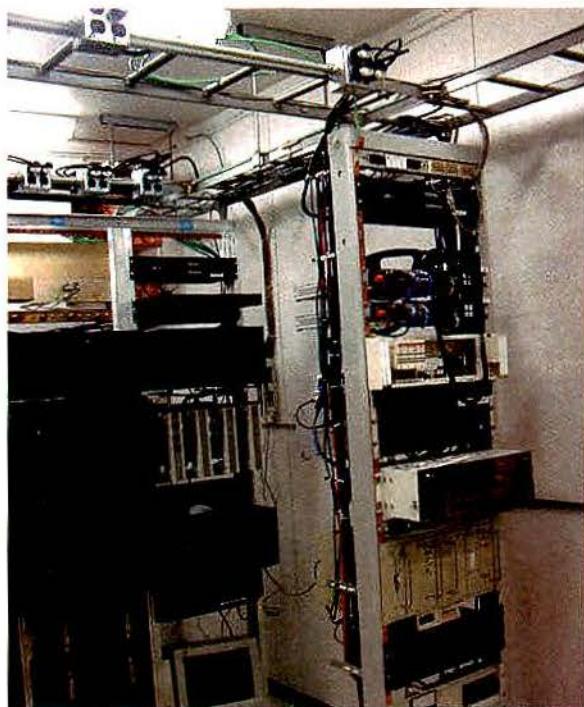


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Virtually identical equipment at each tower site is supported by a UPS and a generator. Consultant Robert Fairbairn said every conceivable failure test was performed. The way it's back up now, it's virtually impossible for something to fail without something taking its place,' he said. Even spare parts are stocked.

and the customer, we are able to provide and support a system that will offer a high level of protection to the residents of Waterbury."

Dave Hattey, Johnson's general manager, said, "The completion and acceptance of the system in Waterbury confirms the project team's tremendous job of serving this

customer and displays our focused attention on resolving legacy challenges. Our centralized efforts in optimizing system design and performance, while firmly supporting our customer base, are reinforced once again."

Johnson gained ground elsewhere in May with a \$900,000 order for radio and control units placed by Nextra, Omaha, NE, a company that serves railways, motor transport companies and utilities with computerized systems that sometimes use two-way radio links. During the same month, Johnson landed a \$2 million contract to supply a communications system to the state of Santa Catarina Police Department in Brazil. Another \$2 million contract announced on April 30 covers a system integration project for Chester County, PA. ■

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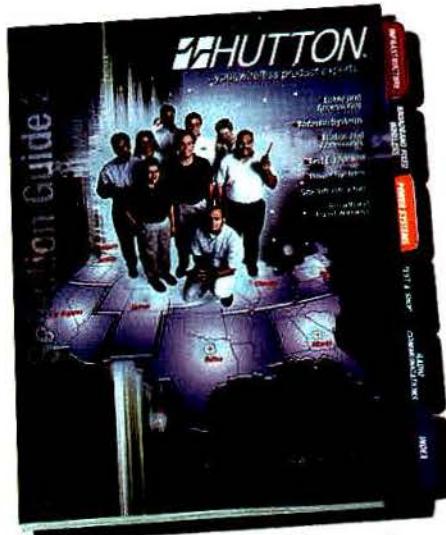
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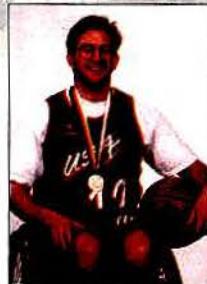
APCO, the Association of Public-Safety Communications Officials—International, is bringing the world together through communications at the 67th annual conference and exposition held in Salt Lake City Aug. 5–9, 2001.

## Conference Featured Speaker

This year's featured speaker at APCO is Mike Schlappi from Orem, UT. Mike is employed by Intermountain Health Care in Salt Lake City, where he is the founder and director of Attitude Therapy, which provides motivational speaking for businesses and organizations.

Mike is a four-time Olympic medalist in wheelchair basketball. He is the only wheelchair basketball player in the United States to be a member of the past four Olympic teams. Schlappi is a member of the board of trustees that will oversee the 2002 Winter Olympic Games to be held in Salt Lake City. Recently, he was honored as one of Utah's top 50 athletes of the century.

In his book, *Bulletproof Principles for Striking Gold*, Mike tells his unique life story, mixed with a profound yet simple philosophy of life. His life story is featured in a national award-winning video, "If You Can't Stand Up, Stand Out."



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## Conference Highlights: Sessions of Interest

□ "Example RF Safety Programs for FCC and OSHA Compliance"—This presentation will provide examples of how to ensure compliance with FCC and OSHA RF safety rules. It will include an overview of the FCC RF safety regulations and example controls for achieving compliance, including the use of an RF safety program and appropriate signage. *Aug. 6, 4:15 p.m.–5:15 p.m.*

□ "Are You Prepared for a Disaster?"—As a communications center manager, Susi Marsan handled the day-to-day operations during the Loma Prieta earthquake in San

Francisco as well as the Oklahoma City bombing and other emergencies. This presentation discusses how a communications center's manager and staff can better prepare to deal with such events. *Aug. 7, 1:45 p.m.–2:45 p.m.*

□ "Field Results: Wideband Data in the New 700MHz Public Safety Band"—Police, fire and EMS units in Pinellas County, FL, use the first wideband data system. Powered by Motorola's technology, the system enables wireless video, VoIP and intranet access simultaneously. This session will discuss

## Special Events

Listen to the Mormon Tabernacle Choir on Sunday, Aug. 5, perform the weekly radio and TV broadcast of "Music and the Spoken Word." APCO members are asked to arrive between 8:45 a.m. and 9 a.m. for reserved seating. The choir will perform "The Battle Hymn of the Republic" as a special request for APCO members after the broadcast.

The Mormon Tabernacle Choir, which was formed in 1836, has more than 300 members who give their time and talents in practices and performances without pay. They perform regularly in the world-famous tabernacle on Temple Square.

MANAPCO's theme this year is "Go for the Gold." Catch the spirit of the Olympic winter games by attending this event on Tuesday, Aug. 7. Performing that evening will be the Flying Aces. This high-flying act will dazzle you while Olympians Trace Worthington and Kris Fedderson jump as high as 25' in the air while wearing snowboards and skis. The Olympic Youth Development Team will simulate the excitement on the ice via rollerblades.

At APCO's closing banquet, watch the traditional changing of the guard as APCO swears in a new president and board. Attire will be business-casual to formal.

field results, highlight requisite technological advances and illustrate operational benefits in the new 700MHz band.

*Aug. 8, 8 a.m.–9 a.m.*

□ "Integrating Public Transit Systems into Public Safety Communications"—Providing a communications solution for a public transit agency through integration with a public safety communications system offers many benefits. It includes a case study of a system that allows police, fire and transit to interoperate.

*Aug. 9, 2:15 p.m.–3:15 p.m.*

## Schedule at a glance

### Sunday, Aug. 5

7 a.m.-5 p.m. Registration  
7:30 a.m.-10 a.m. Chapter representatives' breakfast  
8 a.m.-5 p.m. AFC advisor refresher training  
9 a.m.-5 p.m. Exhibitor booth selection appointments  
8 a.m.-9 a.m. Concurrent sessions

### Monday, Aug. 6

7 a.m.-9 p.m. Registration  
8 a.m.-5 p.m. AFC advisor refresher training  
8:30 a.m.-9:15 a.m. New attendee orientation  
9 a.m.-5 p.m. Exhibitor booth selection appointments  
9:30 a.m.-11 a.m. Opening general session/featured speakers/PSAP awards  
Noon-1:30 p.m. Opening luncheon/keynote address and featured speakers  
1:45 p.m.-3:15 p.m. FCC regulatory panel  
1:45 p.m.-5:15 p.m. Concurrent sessions

### Tuesday, Aug. 7

7 a.m.-7 p.m. Registration  
7:30 a.m.-9:30 a.m. First general business session /awards  
8 a.m.-5 p.m. AFC advisor refresher training  
9 a.m.-5 p.m. Exhibitor booth selection appointments  
10 a.m. Grand opening of exhibits

10:30 a.m.-1:30 p.m. Exclusive exhibit hours  
10:30 a.m.-4:30 p.m. Exhibits open  
1 p.m.-3 p.m. AFC advisor luncheon  
1:45 p.m.-5:15 p.m. Concurrent sessions  
6:30 p.m.-11 p.m. "Go for the Gold" MANAPCO Night

### Wednesday, Aug. 8

7 a.m.-5 p.m. Registration  
7:30 a.m.-10 a.m. Chapter representatives' breakfast meeting  
8 a.m.-5 p.m. AFC advisor refresher training  
8 a.m.-10:15 a.m. Concurrent sessions  
1:45 p.m.-5:15 p.m. Concurrent sessions

### Thursday, Aug. 9

7 a.m.-12 Registration  
8 a.m.- Board of officers meeting  
8:30 a.m.-4 p.m. Corporate advisory committee meeting  
8 a.m.-11:30 a.m. Concurrent sessions  
1 p.m.-3:15 p.m. Concurrent sessions  
6:30 p.m.-7:30 p.m. Closing reception  
7:30 p.m.-9:30 p.m. Closing banquet/awards

### Friday, Aug 10.

7:30 a.m.-3:00 p.m. Fourth Annual Golf Tournament

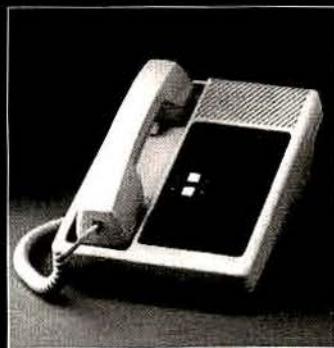
## Salt Lake City attractions

If you have some spare time while in Salt Lake City, check out these attractions:

- Hansen Planetarium.
- Hogle Zoo.
- Tour the Kennecott Copper Mine.
- See the desert in transformation at Red Butte Gardens.
- Shop and learn at the historic Gardner Village.
- Sample pioneer life in Utah at Old Desert Village.
- Get a daily dose of culture at the Utah Museum of Fine Arts, located on the University of Utah campus.
- Visit Beehive House, the official home of Brigham Young.
- For railroad history buffs, see the Heber Valley Historic Railroad.

Stop by the Convention and Visitors' Bureau office located in the Salt Palace Convention Center for more information on Salt Lake City attractions.

## Multi-Channel Remotes for Kenwood -80 -90 and Motorola CDM



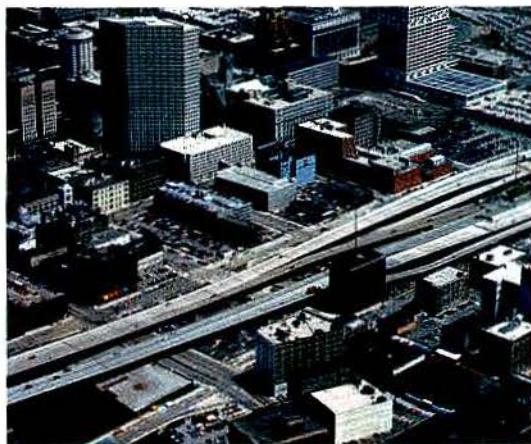
CPI's MCR411A remote and MCP401 termination panel allow two wire (four-wire optional) control for the -90 series radios. The TSR412A and TSP402 are used with the -80 series radio. Channel up and down, group up and down, nine character alpha channel identifier, scan, monitor, intercom, and front panel transmit are all standard features. No programming cables or software are needed. Radio is dedicated to remote operation. Many systems are available for other radios. Please call or visit our website for additional information on this or other CPI products.



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# UTC presents Telecom 2001 in Milwaukee

Home of Harley-Davidson and many famous breweries, Milwaukee served as the host of UTC Telecom 2001 presented by the



The UTC Gala was held at the Milwaukee Public Museum, one of Milwaukee's many attractions.

United Telecom Council from June 24 to June 27 at the Midwest Express Center.

More than 150 exhibitors displayed products and services for utility applications, and about 815 attendees were pre-registered. Representatives from utilities and technology partners from all over the world attended the conference and expo.

The opening general session on June 25 included UTC Chairman

Stephen L. Carrico's state-of-the-council address along with a special welcome from Larry Weyers, chairman of WPS Resources, Green Bay, WI, and a witty special address from Mark Shields, syndicated columnist, author, radio commentator and political correspondent.

Carrico grabbed the audience's attention by arriving at the podium on a Harley-Davidson. In his address, he said that the industry was going through a lot of changes. "We have energy- and utility-industry deregulation, reregulation, restructuring, rebuilding and consolidating. Telecommunications and technology are evolving at light speed."

Carrico said that it was a unique time to "add unprecedented value to our customers, our communities and our shareholders." He also mentioned that managers could not take advantage of opportunities by themselves and that telecommunications was important to utilities' heritage and future.

"Ours is a different business. We're about empowering people and communities, driving economic growth and enlightening lives," Carrico said. "Telecom supports every core mission." Carrico also encouraged utilities to use UTC as a partner.

More than 20 educational ses-

sions covered topics such as voice-over-packet technologies, regulatory issues and wireless standards. A session on land mobile spectrum planning included presentations from Art Brannon, Pacific Wireless; Bob Dawson, Southern LINC; and Al Ittner, Motorola. Dawson offered Southern LINC's IDEN system as an example of how utilities could plan systems. He warned that there was no cookie-cutter approach, however, and that utilities should look for the least-expensive route. Ittner introduced a new technology Motorola is developing, which was spurred by the wideband spectrum in 746MHz. Called "scalable advanced modulation," the technology brings higher speed data applications to customers, with throughput traded for range.

UTC also presented product awards to exhibitors for innovative products. Companies such as Andrew, Comverge Technologies, Granger Telecom, Harris, World Wide Packets, Comsearch, Keller and Heckman LLP and Alltec won product awards.

UTC Telecom 2002 will be held June 23-26 at the MGM Grand Hotel in Las Vegas. Log on to [www.utctelecom2002.org](http://www.utctelecom2002.org) for more information.

—N.C.

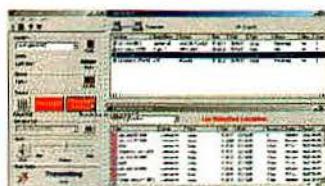
## VoIP provides insurance for police dispatch

The city and county of Honolulu has implemented an Internet protocol radio system

within its police department to increase officer and public safety on the island. As an enhancement to the department's existing EDACS trunked radio system, this sys-

Critical Radio Systems, and uses voice-over-IP technology to distribute audio over an existing WAN or LAN, linking radio and computer users. When a field radio transmits, packetized voice information can be simultaneously routed to multiple dispatch positions across the island. When a dispatcher replies, the audio can be distributed not only to the radio users but also to the other dispatchers across the island.

"IP Radio gives the city's radio system an added robustness that protects it against both natural and man-made disasters," said Curtis McKim, Catalyst's technical lead for the project.



IP Radio allows dispatchers to see the name of the calling officer.

tem serves as a backup to regular police dispatch consoles.

The "IP Radio" system comes from Catalyst Communications Technologies and Com-Net Ericsson

## Motorola system monitors high school

Motorola's Multiservice Networks Division, Mansfield, MA, installed an integrated digital video system that enables remote monitoring of the Tewksbury, MA, High School.

The system delivers real time, on-demand images of strategic locations throughout the school to police headquarters and other off-site emergency service locations.

Tewksbury town officials have designed the Motorola Remote VU system so the cameras remain dormant at the high school until activated by the police.

## Scanning ...

Monroe County, NY, has selected **Intergraph Public Safety**, Huntsville, AL, to provide a county-wide, multijurisdictional, records management system for law enforcement.

The Township of Hamilton Police Department has licensed Troy, MI-based **New World Systems**' public safety suite of software to run on the IBM iSeries 400 platform.

The Charleston, SC, Police Department will implement Castle Hayne, NC-based **VisionAIR**'s interactive paging solution called **I-force**. The contract allows for initial activation of 20 pagers with the department's traffic squad.

Harris, Tampa, FL, has begun shipment of its digital Falcon II radios to the U.S. Army's 82nd airborne division.

The American Mobile Telecommunications Association has become certified by the FCC as a frequency coordinator. The announcement was made by Kathleen Ham O'Brien, deputy director of the Wireless Telecommunications Bureau.

The DB75Q4D08UT autotune combiner from Decibel Products, Dallas, has earned the UL registration.

Sonik Signals, Vista, CA, has acquired the Broadband Wireless Spread Spectrum product line of Radio-Connect, Torrance, CA.

## Project 39 meetings to be held at APCO

The first APCO Project 39 public meetings will be held in Salt Lake City at the APCO National Conference (Aug. 5-10, 2001).

These meetings will consist of pre-conference subcommittee meetings and an open public forum held on Aug. 7 as part of the program for conference attendees. The steering and other committees will meet on Aug. 5 to refine the direction the project will take. The project committees will be looking to the user community for input during the Aug. 7 two-hour session as well as providing information about Project 39.

The goal of Project 39 is to find viable solutions to public safety 800MHz interference situations. The "Best Practices Guide" identified many of the causes, but not the detail required for solutions.

## Motorola appoints Beam Radio as exporter

Beam Radio, a two-way radio communications exporter and system integrator, has been appointed as the two-way radio exporter in Latin America for Motorola. The company has been in the Latin American market since 1976 and is responsible for the expansion of

the LTR 800MHz trunking system in the region.

The company has distribution contracts with Motorola in Jamaica, El Salvador, Peru and Brazil.

Beam Radio will now cover the entire Latin American market from its offices in Miami.

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# The repeater-customer learning curve

A little explanation goes a long way toward customer satisfaction.

By Ernest A. Erickson

Ah, repeaters and those who use them.

Many of you who own or operate a repeater system used by more than one customer (mainly community repeaters) have heard those users complain about others "hogging" the machine. Or, they *themselves* overuse it, but they feel that because they *paid* to use it, they should not have to listen to "those other guys" on it as well.

As I have told many of my customers, "You can't complain about other clients using these systems, as they, too, are paying customers like yourselves."

To confirm *why* they are being subjected to the squawks of others, I ask if they keep the mics on the hook when they are waiting for a call. The most frequent answer is "No, we leave the mic on the *seat* so we can grab it faster. Why do you ask?"

I explain that the radios do not automatically revert to P.L.

## A community repeater is just that: community.

(Motorola private line)-receive mode just because you unkey. The mic must be returned to the hanger for the radio to be on "full P.L." so you don't hear any other users on the machine. That's why we programmed every radio with P.L. on receive.

"Oh, *that's* why we never heard any others for so long (laughing)!"

A community repeater is just that: community. That normally means more than one *company* is using it, too. It means convincing users that they are but one out of several who pay for and use the system. It means coaching them by saying "Out of courtesy, please keep your communications brief and, please, do not use profanity if it can be avoided. Be

considerate to others who could also be hearing what you say and may be offended by some 'off-color' remarks made to your co-workers."

Attracting new customers brings many familiar questions: "Will this service be able to reach us no matter where we are with our trucks?" or "What do I get for this monthly airtime bill?" Maybe you have also been asked "Your service is just like my cellphone, right?" These and so many other questions face us constantly. We attempt to gracefully explain that while we *do* offer communications to many people, *how* it can be of use and service to their company is all in how they make use of it and what they *expect* it to provide them with, as well.

Some potential customers say, "XX dollars per month? It's too high for us. We might as well keep using our cellphones to stay in contact with our drivers."

We come back with "You can *do* that, but let's take a look at a *bigger* picture here, and we'll compare what you now spend each month just to have cellphone use (not to mention the monthly airtime accrued with every minute being billed to you) instead of one, rather low, monthly bill we charge."

In a typical "pitch," we say: "Let's compare what you spend on phone calls each month to the monthly airtime bill we'd send you, and let's see just where the benefits of both lay, OK? Sure, you have a higher initial outlay of cash for radios, antennas and cables, and also a monthly bill for repeater use. But let's average this over a two-year period, and you will see that your cellphone bills are much larger with each passing month compared to having service on our repeater. And those phone bills never go *down*. You are saving money each month by not having to buy or rent those radios, but you are

paying higher use fees. With our repeater system, there's one low, flat-rate bill each month—no matter how many minutes you stay on the air. We use actual drive-outs to 'estimate' system coverage, not simulated coverage maps laid out on the PC. Our method gives the best cost-to-use ratio and provides better planning for customers who might be on the 'fringe' of one system or another."

## Maintenance

Maintaining the repeaters in 100% duty cycle means we must keep spare parts on hand at each site, ready for quick replacement should a pre-amp "go south." Monthly service logs and a complete record of systems checks and alignments are mandatory for us. A repeater that's down, or degraded in service, loses customers faster than lousy restaurant food, and it nearly takes an act of Congress to prove that a dissatisfied customer "jumped ship" prematurely.

Community repeaters are used and needed, but *only* when they serve the customer's needs to the best of their ability. Low cost, reliability and constant availability make community repeaters work for the customer and you. ■

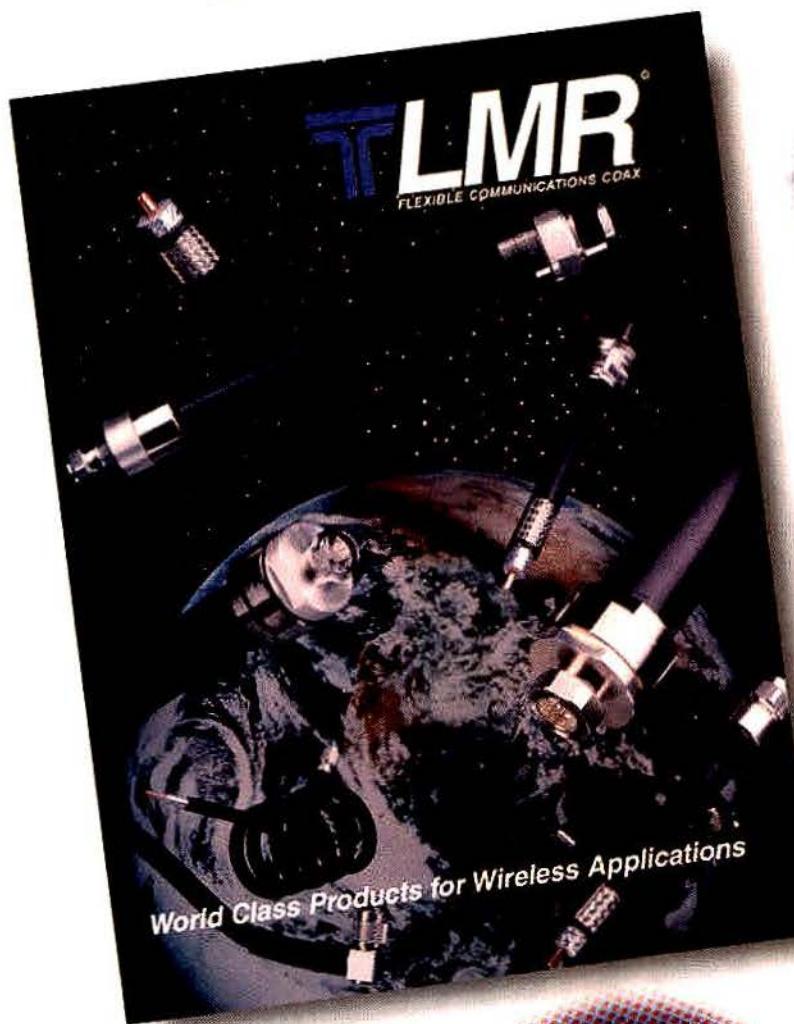
"Point-of-Sale Perspective" is a guest editorial column contributed by and for MRT's radio dealer readers. Opinions expressed here are edited for space; they are those of the author, and may or may not reflect editorial positions of MRT.

MRT pays a writer's fee for each "POS Perspective" column accepted for publication. Commentaries should be about 700-800 words long.

Dealers interested in contributing to this column should contact Kari Taylor, associate editor, by email at [kaylor@intertec.com](mailto:kaylor@intertec.com).

Erickson is the owner of Applied Electronic Communications, Rhinelander, WI.

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### Repeater system mounts in car trunk



The Trunking Gateway from **Futurecom Systems Group** is a vehicular repeater system mounted in the trunk of a car or in a fixed location within a building. It converts a multichannel trunking system into a single conventional channel. This coverage extension concept is embedded in the TETRA specifications and is available for other trunking radio systems, such as Smartnet and EDACS. The system operates like a trunking radio on the system side and as a conventional radio on the local portable side. It receives group and individual calls and retransmits them to the portable radio.

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ing system into a single conventional channel. This coverage extension concept is embedded in the TETRA specifications and is available for other trunking radio systems, such as Smartnet and EDACS. The system operates like a trunking radio on the system side and as a conventional radio on the local portable side. It receives group and individual calls and retransmits them to the portable radio.

**Kenwood Communications'** TKR-750/850 is a basic, self-contained 25W continuous duty rack-mount base station and repeater. It offers rear access to an external speaker output, accessory/logic controller connector (25 pin) and test-speaker-AUX connector (15 pin). It

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### Repeater provides extended coverage



The SVR-200 from **Pyramid Communications** provides extended hand-held coverage by interfacing to existing high-power mobiles and repeating transmission in both directions. The repeater is

PAC/RT-compatible, available in VHF, UHF and 800MHz versions, and works with conventional or trunking mobiles. It is available with remote channel selection and an auxiliary receiver. It has high-pass filters for use with low-band mobiles and pre-selector and notch filters for in-band VHF applications. The repeater offers dual PL tone decode and random sampling.

[WWW.PYRAMIDCOMM.COM](http://WWW.PYRAMIDCOMM.COM)

### Repeater/base station features DSP



**Kenwood Communications'** TKR-750/850 is a basic, self-contained 25W continuous duty rack-mount base station and repeater. It offers rear access to an external speaker output, accessory/logic controller connector (25 pin) and test-speaker-AUX connector (15 pin). It

features wide/narrow channel spacing per channel and has programmable AUX input/output functions.

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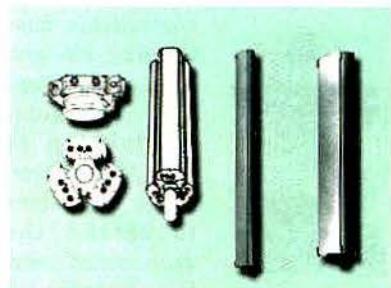
## Mic picks up vibrations in skull

The skull microphone system from **Otto Communications** is designed for most breathing apparatus applications. The lightweight unit is a combination of a skull mic, ear cup receiver and 80mm body PTT. The system picks up the voice through bone vibrations in the head. The mic and ear cup assemblies are encapsulated in molded rubber shells for comfort and protection from the elements. The kit is compatible for four- or five-point facepiece harnesses and webbed-backed harnesses.



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## Antennas used with ASB-3 cluster mount



**Kathrein, Scala Division's** XPV 800MHz vertical/cross polarized panel antennas can now be used with the ASB-3 cluster mounting system. With the cluster mount, a complete three-sector, low visibility antenna system can be erected with a diameter of

18.1". The neutral gray radomes can also be painted to further lessen visual impact. The product provides three antennas, one vertically polarized and one each polarized at +45° and -45°, in the same envelope as a single conventional antenna. The 90° sector antennas are available with 0°, 6° and 12° electrical downtilt. Mechanical downtilt is also an option. Bottom-mounted RF connectors are provided for each array to ease installation. One antenna per sector, rather than three, is required. Just one mounting system, rather than three, is needed. Installation and adjustment is simplified.

[WWW.KATHREIN.COM](http://WWW.KATHREIN.COM)

## Unit supports multiple dispatchers

The ITD3000 desk set from **GAI-Tronics** is useful for trunked radio applications requiring multiple dispatchers at local and remote locations. The unit supports multiple dispatchers, allowing as many as 10 desk sets to communicate over a single LTR base radio. The desk set buttons can fully duplicate all functions on the front

panel of the radio, providing the dispatcher with complete system control.



[WWW.GAI-TRONICS.COM](http://WWW.GAI-TRONICS.COM)

## Extender increases radio coverage

The Multexcom Site Extender from **Futurecom Systems Group** increases the coverage area of an existing radio site by receiving and rebroadcasting the signals from host to user (downlink), and from user to host (uplink). In operation, this product is fully transparent to the user, and system functions are identical whether the extender site or the host site is accessed. All the benefits and features of the host site are supported because voice and data signals are rebroadcasted.

[WWW.FUTURECOM.COM](http://WWW.FUTURECOM.COM)

## Modem offers small size for mounting

**Novatel Wireless** offers the Lancer 3W CDPD wireless modem for mobile access to mission-critical applications such as local, state, NCIC database searches, CAD and messaging. This modem features MIL-STD 202F vibration compliance, extended temperature range tolerance and wide input voltage range allowance. The small size allows for a variety of mounting options such as in the console, on the cage or in the trunk.

[WWW.NOVATELWIRELESS.COM](http://WWW.NOVATELWIRELESS.COM)

## Software maintains public safety

The Datalink Mobile Messaging software package from **IP Mobile-Net** offers a text-to-speech capability. The software enables mobile operators to send messages and request information from an external database, CAD dispatchers or other mobile operators. This product interfaces seamlessly with magnet strip reader hardware to allow officers to scan a driver's license from any state. Automatic vehicle locator and a mapping package are also integrated into the software.

[WWW.IPMOBILENETINC.COM](http://WWW.IPMOBILENETINC.COM)

### Enclosure offers portable, shielded design



**Lindgren RF Enclosures'** Table Model Enclosure fulfills requirements for EMI/RFI, EMS, EMC and cell-to-cell testing. The enclosure is

portable and designed for fast, convenient EMI/RFI testing in a tabletop, rack-mounted or in-line format. This model is constructed of 24-ounce copper shielding and may be equipped with computer-controlled pneumatic RF doors.

[WWW.LINDGRENRF.COM](http://WWW.LINDGRENRF.COM)

### Combiners employ dual-junction isolators

**Decibel Products'** DB4398 series hybrid combiners are for 800MHz-900MHz SMR trunking. They are designed for use with Motorola's IDEN signaling application system. Using dual-junction isolators to yield greater-than-75dB transmitter-to-transmitter isolation (typical), the convertible design permits variable combining

for narrow frequency separations. It features an insertion loss of between 3.8dB and 7.1dB and a harmonic rejection of greater than 80dB. The units are provided in two styles with adequate ventilation: bracket-mountable with a convection cooling system or two-rack unit tray with fan option.

[WWW.DECIBELPRODUCTS.COM](http://WWW.DECIBELPRODUCTS.COM)

### Intrinsically safe batteries fit Ericsson, Motorola

Rechargeable replacement batteries for the Ericsson/GE LPE Series, Motorola HT750/1250, GP350, P1225, Visar and XTS-3000 radios are available from **Multiplier Industries**. The batteries are intrinsically safe & non-incendive. They are approved by Factory Mutual Research in meeting the same standards as the OEM. The M191203/2 for Ericsson/GE

LPE series radios is a NiCd, 7.5V battery and offers 1,200mAh capacity. The M9010 for the Motorola HT series of radios is a NiMH, 7.5V battery that offers 1,600mAh capacity. For Motorola Visar radios, the M7397 is a NiMH battery with 7.5V and 1,500mAh capacity. All batteries are designed for the exact fit to the radio and charger. Multiplier's Sure-grip surface is also available.

[WWW.MULTIPLIER.COM](http://WWW.MULTIPLIER.COM)

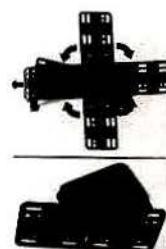
### Console boxes allow 36 combinations

The EPIC console boxes from **Gamber-Johnson** are available in 13" and 17". The boxes have rounded edges that ensure passenger safety. They offer a two-piece flexible design allowing for 36 height/angle combinations to accommodate deeper equipment and to offer better viewing of radios. The boxes feature multiple knock-out panels and cutouts for quick wiring, pre-cut sidewall slots for light bracket mounting and bottom holes for simple installation.

[WWW.GAMBERJOHNSON.COM](http://WWW.GAMBERJOHNSON.COM)

### Brackets extend mount's surface area

**PanaVise Products'** series of extension brackets increase the mounting capabilities of AMPS-compatible custom dash mounts. Adjustable extension brackets, available in 4" and 5" lengths, allow installers to extend the dash mount's surface area for



installation of hands-free kits with privacy handsets or phones with PDA/GPS systems.

[WWW.PANAVISE.COM](http://WWW.PANAVISE.COM)

*Continued on page 66*

# Base Station, Trunking and SMR

Tx-Combiner

**fiplex**

COMMUNICATIONS INC.  
7331 NW 54th Street - Miami FL 33166 - USA - Ph (305) 884-8991 - Fax (305) 884-4041  
E-mail: [fiplex@bellsouth.net](mailto:fiplex@bellsouth.net) / Web site: [www.fiplex.com](http://www.fiplex.com)



UHF 300 Watts  
Base Station  
Duplexer



Receiver  
Multicoupler

CIRCLE (55) ON FAST FACT CARD

Company	Page Number	Fast Fact Number	Advertiser Hotline	Company	Page Number	Fast Fact Number	Advertiser Hotline
AC/DC Industries	74	108	281-933-0909	I-Tech	36	34	619-458-1500
Advance Reciever Research	59	50	860-485-0310	JEI Communication	28	27	530-677-3210
AeroComm	7	8	201-227-0066	Jotto Desk	26	24	501-636-5776
Alexander Technologies	49	42	515-429-8955	JPS Communications	16	14	919-790-1011
Alltec	68	53	800-203-2658	Klein Electronics	77	114	760-781-3232
Anritsu Company	21	19	800-ANRITSU	Midian Electronics	29	28	520-884-7981
Astron Corp.	25	23	949-458-7277	Modular Communication	17	16	818-764-1333
Avtec, Inc	35	33	803-892-2181	Modular Communication	19	17	818-764-1333
Barnett Electronics	77	115	800-423-3858	Omicron Electronics	62	58	860-928-0377
Berkeley Varitronics	11	10	908-548-3737	Open Sky	1	4	877-OPENSKY
Cadex Electronics	34	32	604-231-7777	Polaris Industries	76	111	404-872-0722
Canadian Wireless	40		613-233-4888	Pryme Radio Products	46	40	714-257-0300
Carlson Wireless Tech.	9	9	707-923-9593	Pyramid Communications	72	101	714-901-5462
David Clark Co, Inc	47	41	508-751-5800	Avcom Ramsey Tech.	77	116	800-446-2295
CMC Enterprises	73	102	336-769-2885	RCC Consultants Inc.	59	51	804-422-8456
Comms. Specialists	BC	3	800-854-0547	RCC Consultants	79	120	732-404-2400
Control Signal Corp.	66	47	800-521-2203	Relm Communications	67	57	800-821-2900
Cook's Communication	76	112	559-233-8818	Relm Communications	69	59	800-821-2900
CPI Communications	57	49	972-429-7160	Relm Communications	IBC	2	800-821-2900
Crescend Technologies	54	46	800-872-6233	RF Imaging and Comms	73	103	925-229-2034
CTA-Amerizon Wireless	78	117	219-484-0486	Ritron Inc.	62	60	800-USA-1USA
CTA-Amerizon Wireless	78	118	219-484-0486	RSI	26	25	316-825-4600
Daniels Electronics	12	11	604-382-8268	Sacramento Comm.	75	109	209-755-4949
Dataradio	22	20	770-392-0002	Schwaniger & Associates	33	31	202-347-8580
Datron World Comms.	15	13	760-597-3814	Shure Communications	41	37	847-353-3100
Decibal Products	13	12	214-819-4281	Simulcast Solutions	75	110	716-223-4927
DLC	51	44	562-404-9998	Sinclair Technologies	20	18	905-727-0165
Duracomm Corp.	54	54	816-472-5544	SoftWright	78	119	303-344-5486
EDX Engineering	24	22	541-345-0019	Swager Communications	76	113	800-968-5601
E.F. Johnson Company	37	35	800-328-3911	Telewave Inc.	5	7	650-968-4400
El Paso Comm. System	73	104	915-533-5119	Thunder Eagle	50	43	703-242-0122
EML	73	105	615-771-2560	Times Microwave Systems	61	52	203-949-8400
Fiplex Communications	64	55	305-884-8991	Transcrypt International	32	30	800-894-2609
Fiplex Communications	72	100	305-884-8991	TX RX	3	5	716-549-4700
Futureecom	27	26	904-860-5546	United Communications	74	107	888-763-7550
Gamber Johnson	53	45	715-344-3482	Vega/Telex Signaling	4	6	402-467-5321
Hutton Communications	55	48	800-422-3811	VERTEX/YAESU USA	IFC	1	310-404-2700
ICOM America	23	21	206-450-6041	WETEC	73	106	901-286-6275
IDA Corporation	16	15	701-280-1122	Zetron	45	39	425-820-6363

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### Surge suppressor module features MOV

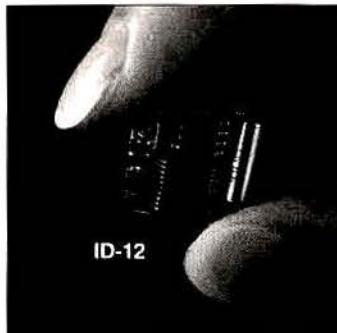
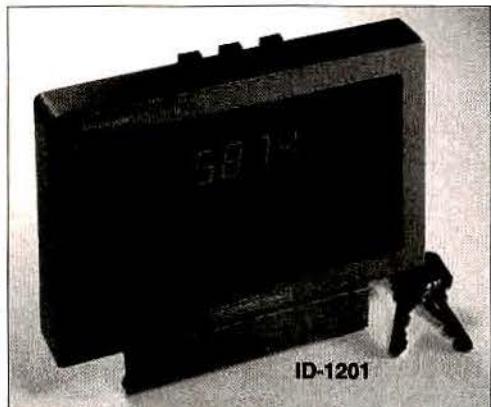
The Strikesorb surge suppression module from **AC Data Systems** features a distribution-grade, metal-oxide varistor. The module overcomes the MOV's traditional

vulnerability to degradation and catastrophic failure while offering high energy handling capacity and extended product life.

[WWW.SURGEBOX.COM](http://WWW.SURGEBOX.COM)

### Digital ANI

### MDC-1200® Signaling



**CSC** **CONTROL SIGNAL®**

[www.ControlSignal.com](http://www.ControlSignal.com)

Control Signal's ID-12/1201 is an economical **MDC-1200 ANI** system. The ID-12 encoder works in all radios and fits in virtually all handhelds and mobiles. The ID-1201 decodes any **MDC-1200 ANI** signal, has a large LED display, a printer port and an RS232 port.

MDC-1200 is a registered trademark of Motorola Inc.

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CIRCLE (47) ON FAST FACT CARD

### OUTDOOR ENCLOSURES

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(78"H x 48"W x 48"D)



- Powdered textured finish available
- Adjustable rails (front to rear)
- 4 sets of rails-19" EIA (23" available)
- Four doors
- Available in: **two heights...**
- 50 inches and 78 inches

**D.D.B.**

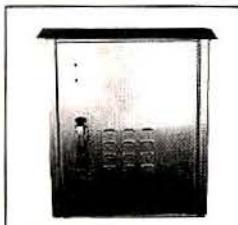
UNLIMITED INC.

**800-753-8459**

[www.ddbunlimited.com](http://www.ddbunlimited.com)

#### OD-30DX

(30"H x 25"W x 25"D)



- Available in: **four heights...**
- 30 inches, 50 inches, 62 inches & 78 inches and **three depths...**
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- Vents—Front and rear, top and bottom with filtered panels (included)
- 19" EIA (23" available)

Fans, A/C Units &  
Heaters Available

CIRCLE (56) ON FAST FACT CARD

### Combiner features low insertion loss

The **Narda** SMA power combiner and divider provides isolation and a low insertion loss throughout the frequency range of 1,900MHz-2,500MHz. Model 4162 is available from stock in eight-way and 16-way versions.

[WWW.DEPT26.COM](http://WWW.DEPT26.COM)



### Portable radio delivers 512 channels

**Vertex Standard's** VX-900 public safety portable series, in both UHF and VHF, delivers 512 channels that can be partitioned into as many as 20 memory groups, with no limit on the number of channels within each group. This flexibility allows a single radio to be programmed with channel sets for a variety of jurisdictions or organizations. This product offers a one-piece, die-cast aluminum chassis with a weather-sealed mic connector, noise-canceling microphone and 700mW audio output.



[WWW.VXSTD.COM](http://WWW.VXSTD.COM)

### Charger includes transformer

The six-unit Rapid-Charger from **Klein Electronics** offers interchangeable charger slots for users who need to charge different radio or battery models at the same time. The charger includes an internal transformer, which makes it easier to transport. The total weight is 6lbs. A "plus" model includes a full discharger function so the batteries are fully depleted and last longer.

[WWW.KLEINELECTRONICS.COM](http://WWW.KLEINELECTRONICS.COM)

# The S-Series Repeater

## Antenna is injection molded

The EXS model from **Centurion** is an injection molded quarterwave helical "slim mini" antenna. The antenna features a textured finish with a strain-relief base. This product is available in various standard connectors.

[WWW.CENTURION.COM](http://WWW.CENTURION.COM)

## Station eliminates need to calibrate

The MBT 250 SDTP multifunction rework station from **PACE** features Sensatemp heat delivery technology that ensures accurate temperatures and eliminates the need for calibration when hand pieces or heaters are changed out.

This system is useful for rework and repair applications as it provides a platform for soldering, desoldering and SMD removals.

[WWW.PACEWORLDWIDE.COM](http://WWW.PACEWORLDWIDE.COM)



## Software uses speed of Internet

**GenCore International's** 100% Windows-based customer billing and management software, Genesis Trio, is designed for Motorola's Harmony and IDEN digital infrastructures. The software bills clients and creates system management reports. This product uses the convenience and speed of the Internet to provide Web-based support, live software updates and dealer access to view client information and to fill out order forms online. Each report and graph is selectable and available on demand. Users can create their own ad hoc reports by using a query to specify their parameters and date ranges. Airtime information is accumulated and available for reporting on a near real-time basis. The user will never have to go back and do a time-consuming crunch or process records to have access to the system information.

[WWW.GENESISWORLD.COM](http://WWW.GENESISWORLD.COM)

## Controller responds to commands

The TNT-60 dispatch controller from **Trident Micro Systems** offers single period airtime logging with a hit counter and a user-programmable Morse code identifier. This controller can generate the sync signal or be a slave unit on any system with an LTR or RNDL data bus. The unit will also respond to validation commands from your existing ID validator or another controller in the TNT series.

[WWW.TRIDENTMS.COM](http://WWW.TRIDENTMS.COM)

### Available Frequency Ranges

66-80\* MHz  
70-88\* MHz  
135-160 MHz  
148-174 MHz  
195-225\* MHz  
320-350\* MHz  
345-375\* MHz  
400-435 MHz  
450-485 MHz  
485-520 MHz  
806-870 MHz

### Standard Features

25/12.5 KHz Channel Spacing  
225 Channels (Binary)  
CTCSS/DCS  
Thermal Controlled Fan  
50 Watts RF Output  
(below 800 MHz)  
35 Watts RF Output  
(above 800 MHz)  
Conforms to TIA/EIA 603  
-30 to +60 C Operating Temp

### Built in Remote Diagnostics

Voltage, Temp, VSWR, TX Power,  
RSSI, VCO Volts

### Optional Features:

Digital Operation  
Cross-banding  
Expanded RF Power Output  
Simplex Change over relay  
(Base/Simplex Operation)

\*For export and Federal Government only



**RWC**  
RELM Wireless Corp.

[WWW.RELM.com](http://WWW.RELM.com)



### LMDS antennas offer rigidity

The LMDS CPE antenna from **Andrew** is for broadband applications in the 27.5GHz-31.5GHz frequency band. These lightweight antennas provide a gain of 36.6dBi at 28.5GHz. The antennas are pre-

sion-molded from white ASA plastic for toughness and rigidity. The material resists weathering, aging and yellowing or graying. The optical surface is coated with a high conductivity, silver alloy for reflectance and long life. Antennas can be custom configured to interface with customer-specified equipment.

[WWW.ANDREW.COM](http://WWW.ANDREW.COM)

### System offers high-bandwidth networking

**AeroComm's** Redlink infrared communications system offers organizations quick deployment of high-bandwidth fixed wireless network links as a low-cost wireless alternative to fiber optic and copper local loops. This product line provides high-bandwidth network-

ing for wireless network backhaul, last-mile connectivity, high-speed LAN-to-LAN links and building-to-building communications to various businesses. These systems offer the ability to deploy inter-building ATM and fast Ethernet/FDDI.

[WWW.AEROCOMMINC.COM](http://WWW.AEROCOMMINC.COM)

### Tower site unit monitors 32 alarm points

The DM-32 tower site monitoring unit from **Hark Tower Systems** offers contact closure inputs for monitoring as many as 32 alarm points at a tower site. Each input and site name can be labeled with

an alphanumeric message to identify which alarm is reported. Both ac power voltage and cabinet temperature are available as additional alarm options.

[WWW.HARKSYSTEMS.COM](http://WWW.HARKSYSTEMS.COM)

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CIRCLE (53) ON FAST FACT CARD

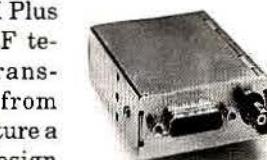
### Portable radio offers 128 channels



At 9.5 ounces, the **Motorola** EX600 expert series portable radio features 128 channels, six programmable buttons and telephone interconnect capability. It offers user-friendly icons on a large 14-character alphanumeric display, plus a full range of signaling capabilities that allow a user to send and receive information in a variety of ways.

[WWW.MOTOROLA.COM](http://WWW.MOTOROLA.COM)

### Telemetry transceivers offer low bit-error rate



The DTX Plus series of RF telemetry transceivers from **Ritron** feature a compact design that make them suitable as a retrofit to Rnet and JSLM installations. Direct modulation with low distortion and low group delay result in a low bit-error rate for an enhanced system. Approved by the FCC for narrow and wideband specifications, the small transceiver is available in 6W VHF (136MHz-174MHz) and 3W/6W/10W (400MHz-470MHz) versions.

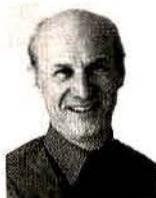
[WWW.RITRON.COM](http://WWW.RITRON.COM)

### Radio extends LANs

**ADTRAN's** Tracer 2631 is a license-free digital microwave radio that provides wireless IP routing and digital voice transmission. This radio uses spread-spectrum technology, allowing carrier and enterprise customers to extend LANs to previously unreachable locations. This product allows coverage options for the 2.4GHz or 5.8GHz frequency bands.

[WWW.ADTRAN.COM](http://WWW.ADTRAN.COM)

## Changing Channels



Dennis

Former *Communications* magazine editor **George Dennis** exits Telecordia Technologies, Morristown, NJ, as founder and manager of its competitive intelligence unit and opens an office in Denver as regional vice president for Huntsville, AL-based Phoenix Consulting Group to market the company's intelligence and training services.



Uxa

**Michael Uxa**, regional sales manager for the professional and cellular product lines, advances to national sales manager for the Consumer Products Group for Antenna Specialists, Cleveland.

**Mike Bayly** departs Securicor Wireless, Kansas City, MO, as director of linear modulation market development to found Bayly Presentations, Overland Park, KS. [www.baylypresentations.com](http://www.baylypresentations.com).

**Susan Ness**, former commissioner at the FCC, joins the board of directors of LCC International, Maclean, VA.

Appointments at Strand Marketing, Burlington, MA:

**Allison O'Connor** joins the company as sales representative for Identity Domain after leaving VerticalNet where she was industry manager for the RF GlobalNet and Wireless Design Online communities. **Kyle McNamara** takes on new responsibilities as vice president of operations after leaving his position as vice president of business development and technology.

Promotions at ComSpace, Coppell, TX:

**Randall West** moves up to senior vice president of engineering. **David Kornley** leaves Motorola's Base Transceiver System Center of Excellence to join the company as vice president of engineering.

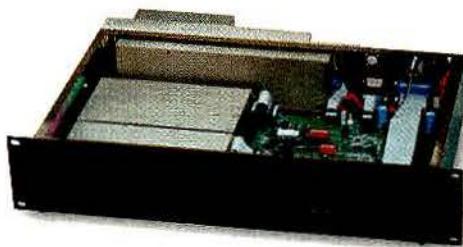
**Diane Cornell**, formerly associate bureau chief of the Wireless Telecommunications Bureau of the FCC, is appointed vice president for regulatory policy for CTIA, Washington.

**Richard J. Brockway** advances to vice president of public safety products at Thales Communications, Rockville, MD.

**James Hadzoglou** of Antenna Specialists, Cleveland, is awarded U.S. Patent No. 6,215,451 B1 as of April 10, 2001, for technology used in dual-band "On-Glass" antennas at cellular and PCS frequencies.

**Bill Ward** of Henry County, IN, Sheriff's Department receives the "Radio Hero Award" in recognition of his having used his Citizens Band radio in the capture of two suspected murderers.

Looking for a feature rich repeater?



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### The S-Series

from

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**RELM**  
**BK RADIO**  
**Uniden PRC**  
Private Radio Communications

CIRCLE (59) ON FAST FACT CARD

### August

**5-9: Association of Public-Safety Communications Officials-International (APCO) National Conference**, Salt Palace Convention Center, Salt Lake City. Contact: 904-322-2500 or [www.apco-intl.org](http://www.apco-intl.org).

### September

**11-13: PCIA GlobalXChange**, sponsored by the Personal Communications Industry Association, Los Angeles Convention Center, Los Angeles. Contact: 703-739-0300 or [www.pcia-expoventure.com](http://www.pcia-expoventure.com).

**10-13: CTIA Wireless I.T. & Internet 2001**, San Diego Convention Center, San Diego. [www.wirelessIT.com](http://www.wirelessIT.com).

**12-13: C.O.P.S. West**, produced by the California Peace Officers' Association, Ontario Convention Center, Ontario, Canada. [www.copswest.com](http://www.copswest.com).

**19-22: Private Wireless Spectrum Management Conference & Expo**, sponsored by Industrial Telecommunications Association, the Council of

Independent Communications Suppliers and the USMSS, Grand Hyatt Hotel, Washington. Contact: Ray Wisniewski at 703-528-5115 or email: [ray@ita-relay.com](mailto:ray@ita-relay.com).

### November

**6-8: Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888, ext. 102, or [www.cwta.ca](http://www.cwta.ca).

**6-11: Communications Marketing Conference**, DoubleTree Hotel Tucson-Reid Park, Tucson, AZ. [www.commktga.com](http://www.commktga.com).

**12-15: AMTEX 2001**, sponsored by the American Mobile Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. Contact: 202-331-7773. [www.amtausa.org](http://www.amtausa.org).

**12-15: IWTA 2001 Expo**, sponsored by the International Wireless Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. Contact: 202-331-7773. [www.iwtaexpo.com](http://www.iwtaexpo.com).

Miami. [www.iwta.org](http://www.iwta.org).

**16: Radio Club of America Annual Awards Banquet and Technical Symposium**, New York, [www.radio-club-of-america.org](http://www.radio-club-of-america.org).

## 2002

### February

**19-22: NATE**, sponsored by the National Association of Tower Erectors, Orlando, FL. Contact: 888-882-5865 or [www.natehome.com](http://www.natehome.com).

### March

**7-10: Entelec 2002**, George R. Brown Convention Center, Houston. [www.entelec.org](http://www.entelec.org).

### April

**24-26: International Wireless Communications Expo**, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. [www.iwceconexpo.com](http://www.iwceconexpo.com).

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## MCCON

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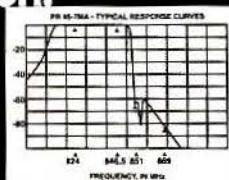
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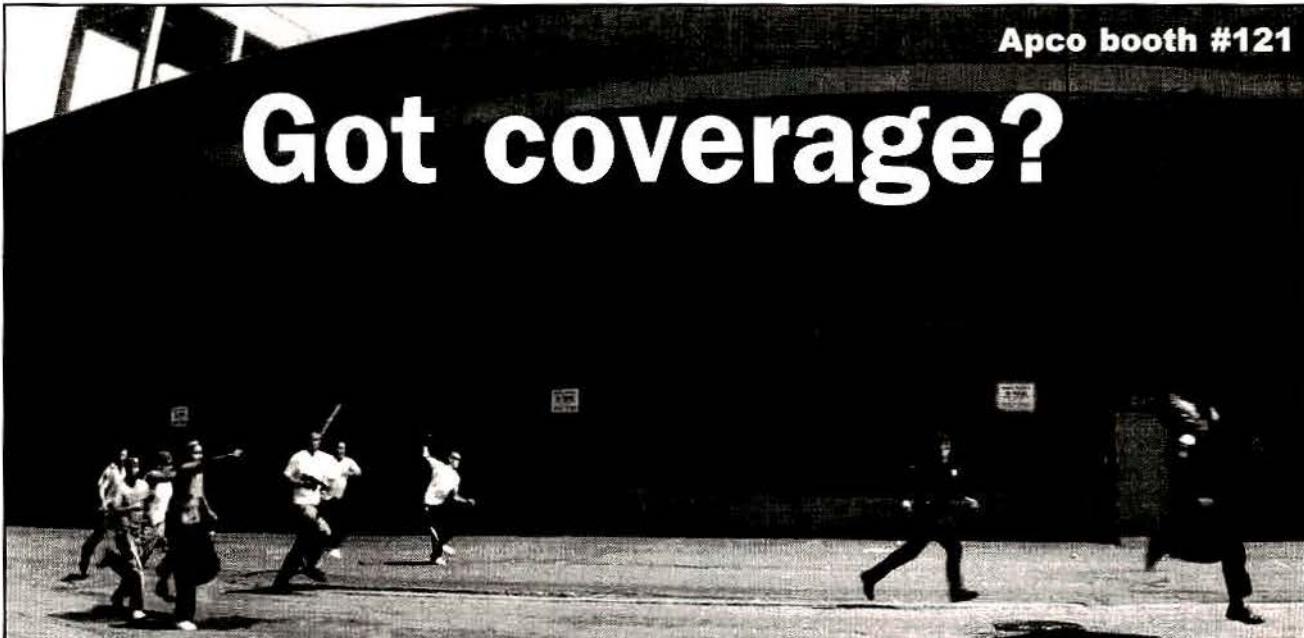
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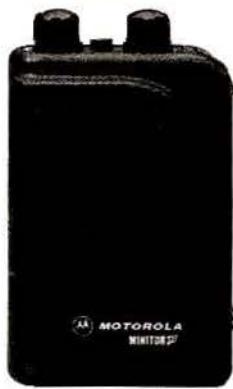
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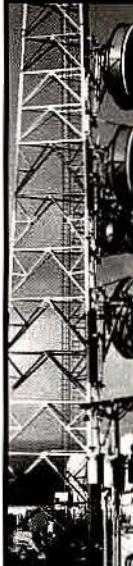
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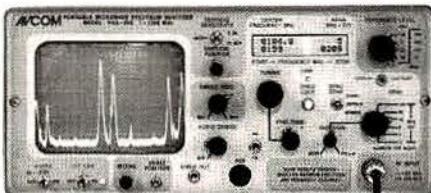
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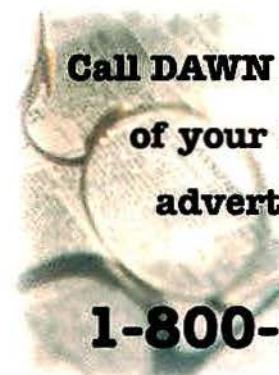
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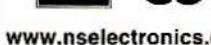

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# Never ignore the human factor

A couple of months ago I mentioned that I'm good for a "few" war stories. So here we go. It was in

the mid-'80s. There I was, flying at 30,000 feet ... er, make that driving down I-70. I was aboard the LFV Aerostar (Lesser's Family Vehicle, and it was a Ford Aerostar). My co-pilot was my wife, Judy.

My son Ben was behind me, manning the hot seat (he had the sun), and my daughter Carly was positioned in the "Are we there yet?" seat.

As we drove down the highway through the expanse of Kansas, we observed strange-looking beasts. A local native referred to them as heifers. Bizarre. But then I'm a city boy. What do I know?

## And then it happened

The LFV was on autopilot as I looked for bandits (state patrol) who might slow our progress back to our home base in Denver. It was

then that it happened. The LFV began to lose forward thrust. The speed indicator was falling off rapidly. Outside air temperature indicated in excess of 100°. Engine oil temp took a nosedive, and I was forced to make an emergency stop. It was obvious what had happened. The LFV cooling system had failed.

We were in the middle of a hostile environment. Nothing but waves of heat and heifers surrounded us. As commander of the LFV, it was my responsibility to take immediate action. I quickly jumped from the vehicle and performed a quick-thinking maneuver—I slapped electrical tape around the offending tube, threw what water was available into the cooling system and headed West with a prayer on my lips: "Dear

Lord, where the heck is a cop or a gas station when you need one?"

Well, here it is some years later. I now have a cellphone that I carry with me when I travel. I really am one of those folks who rarely uses a cellphone. I carry one for roadside emergencies. Do I feel better today than I did in the mid-'80s? Yes and no. Yes, when I'm near a major city and, no, when I'm on the open road (as I was in the LFV).

## Technology is great but ...

While I've had some fun recreating my war story for you, I realize that the need for emergency communications is no joking matter. People get in trouble when they are on the road. The problems range from car troubles to medical emergencies. Having a cellphone can make the difference between getting rescued, or getting to a hospital.

But, it isn't always going to help.

Not long ago a woman in Kansas City, MO, lost her life because the police could not find her location based on the signal from her cellphone. Here in Colorado, a man was driving down a rural road when he suffered a heart attack. He died before help could reach him because the police went to the wrong location. The man had told them he had just passed a church. The police went to the wrong church.

Although depending on technology is important, one factor cannot be ignored—the human factor.

## Dispatchers are the key

While we await the completion of E9-1-1, the key to making communications work is the dispatcher. They have what I consider to be one of the most difficult and important jobs in public safety. They have to make quick decisions often with little information.

Although E9-1-1 will be a great tool for public safety officials to have, the need for the dispatcher to make a decision and communicate it to the right individual (or agency) is paramount. E9-1-1 will help, but

it will be the dispatcher who makes the call.

## Thank goodness for radio

How do they do it? Well, with good ol' dependable radio technology. While there is talk of more use of cellular technology by public safety agencies, I believe it will be some time before that happens. Thus, the need still exists to maintain legacy systems, and, where possible, to upgrade to new radio systems. And, if you, dear reader, are a decision maker who is looking into new systems, let me offer you one word of advice: interoperability.

This is an issue I find frustrating. This should be a no-brainer. Interoperability should be on the top of every public safety manager's agenda. The barrier is cost—Who is going to pay for it? If the funds are not coming from an outside source (i.e., the Feds), then any changes will be a long time in coming.

But, even when we get interoperability, the human factor cannot be ignored.

## And thank you

I can't tell you how much I've appreciated the emails welcoming me to the *MRT* team. I really do enjoy hearing from readers, and to get this kind of email is awesome. We are always looking at how we can serve our readers better. What better way to find out than to exchange communications? Please email or call me with your opinions and ideas. I answer my phone and usually respond to email within the hour. I promise to keep the war stories to myself.



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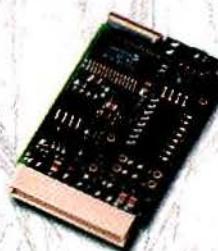
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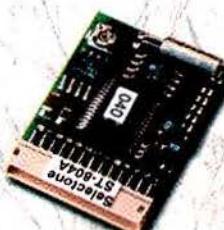
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Decodes address codes of 1 to 7 digits from all 16 DTMF characters.  
Multiple outputs and remote reset capability.  
PC programmable with optional kit, or factory programmable for free.  
1.34" x 0.85" x 0.21"  
\$59.95



#### ST-888

Desktop ANI Decoder / Display Unit  
Use with ST-804A or other DTMF ANI encoders for monitoring of fleet radio users and control systems.  
\$499.00



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